REPORT RESUMES

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ROOFING, PART I. WORKBOOK.
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THE TECHNICAL INFORMATION IN THIS STUDY GUIDE WAS DEVELOPED FOR USE IN RELATED INSTRUCTION IN APPRENTICE TRAINING PROGRAMS FOR ROOFERS. THE MATERIAL WAS PLANNED UNDER THE DIRECTION OF THE STATE EDUCATIONAL ADVISORY COMMITTEE FOR THE ROOFING TRADE AND PREPARED UNDER DIRECTION OF THE BUREAU OF INDUSTRIAL EDUCATION. THE UNITS ARE (1) THE APPRENTICE ROOFER AND HIS TRADE, (2) INFORMATION FOR THE BEGINNER ROOFER, (3) MATERIALS, TOOLS, AND EQUIPMENT, (4) ROOF PREPARATION, AND (5) KETTLES AND KETTLE OPERATIONS. EACH UNIT IS INTRODUCED BY AN EXPLANATORY STATEMENT AND IS DIVIDED INTO STUDY TOPICS. A TYPICAL TOPIC HAS AN ASSIGNMENT FROM REFERENCE MATERIAL, AN INTRODUCTION OF BACKGROUND INFORMATION, A SECTION OF RELATED INFORMATION, AND CHECKUP QUESTIONS FOR STUDENT SELF-EVALUATION. PHOTOGRAPHIC AND LINE-DRAWING ILLUSTRATIONS ARE INCLUDED IN THE RELATED INFORMATION. SPACE IS PROVIDED IN THE STUDY GUIDE INDEX FOR RECORDING TOPICS COMPLETED. THE STUDY OF THE 144-HOUR COURSE BY INDENTURED APPRENTICES ON A GROUP OR INDIVIDUAL BASIS IS TO BE DIRECTED BY A QUALIFIED JOURNEYMAN OF THE TRADE. A GLOSSARY OF TRADE TERMS WITH DEFINITIONS PERTINENT TO THE ROOFING TRADE IS PROVIDED. RECOMMENDED SUPPLEMENTARY INSTRUCTIONAL MATERIALS FOR THE APPRENTICE AND THE CLASSROOM LIBRARY ARE LISTED. TESTBOOKS AND FINAL EXAMINATIONS ARE AVAILABLE TO THE INSTRUCTOR. THIS DOCUMENT IS ALSO AVAILABLE FOR $2.00 FROM BUREAU OF INDUSTRIAL EDUCATION, CALIFORNIA STATE DEPARTMENT OF EDUCATION, 721 CAPITOL MALL, SACRAMENTO, CALIFORNIA 95814. "ROOFING, PART 2," VT 002 795, IS ALSO AVAILABLE. (HC)

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ROOFING
Part I

WORKBOOK

VT002989

CALIFORNIA STATE DEPARTMENT OF EDUCATION
MAX RAFFERTY, Superintendent of Public Instruction
Sacramento, California, 1964

MEMORANDUM

TO: The ERIC Clearinghouse on Vocational and Technical Education
The Ohio State University
980 Kinnear Road
Columbus, Ohio 43212

FROM: (Person) Wallace Theilmann (Agency) California State Dept. of Ed.

(Address) 721 Capitol Mall, Sacramento, California 95814

DATE: July 25, 1967

RE: (Author, Title, Publisher, Date) ROOFING, Part 1, workbook, 1964 edition.
Prepared under the direction of the Bureau of Industrial Education.
California State Department of Education

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Necessary XXX
Desirable ____ (Check Which)
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ROOFING
Part I

WORKBOOK

1964 Edition

Prepared Under the Direction of the
Bureau of Industrial Education

APPRENTICE'S NAME____________________
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Foreword

The provision of related courses for apprentices to supplement their training for the trade is a relatively recent development. Since these courses are highly specialized, a comparatively few commercially prepared training manuals are available. The California State Department of Education has therefore developed manuals of this type that can be used by the schools for this purpose.

We are confident that the young men who have chosen to work in this trade and the journeymen who are instructing them will find participation in these courses both helpful and stimulating.

Max Rafferty

Superintendent of Public Instruction

Preface

The Bureau of Industrial Education has responsibility for making available the related instructional materials for use in the training programs offered by the apprenticeable trades. The Bureau meets this responsibility by working cooperatively with employer-employee groups representing each of these trades in determining what materials are needed and in developing these materials.

The 1964 edition of Roofing, Part 2, was planned under the direction of the State Educational Advisory Committee for the Roofing Trade. The membership of this committee included the following representatives of employers and of employees.

Employer Representatives	Employee Representatives
Charles Ashbourne, Long Beach	William Jerrold, Sacramento
Robert Baker, Oceanside	Francis McCarthy, Los Angeles
Vern Potter, Riverside	Thomas Moore, San Francisco
Edward D. Weyand, Sacramento	M. L. Van Dyke, San Diego

Wallace Theilmann of the Bureau of Industrial Education has responsibility for maintaining liaison with industry groups who are interested in the preparation of instructional materials.

John Fredricks, Francis McCarthy, and William Woltjes assumed the responsibility of the revision of Roofing, Part 1. Edward D. Weyand and Richard Isaacs assisted them in the preparation of certain units of the course.

DONALD E. KITCH
Acting Chief,
Division of Instruction

ERNEST G. KRAMER
Chief, Bureau of
Industrial Education

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Assignment Date

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Instructions for Checkup Questions

Checkup questions appear at the end of each topic in the workbook. Answer the questions for each topic as soon as possible after you finish studying the assignment. Remember that although you are not graded on the checkup questions, your ability to answer them correctly can show you how well you understand the information and assignments in the topic preceding them.

Checkup questions of the following types appear most often throughout this course: true-false, completion, and group discussion.

True-false questions are statements followed by the letters T and F. If you believe the statement is more nearly true than false, circle the letter T. If you believe it is more nearly false than true, circle the letter F.

Completion questions are sentences in which certain key words are omitted. A numbered blank is placed in the right-hand margin to correspond to each of the missing words. Write the required word in the blank with the correct number.

Group discussion questions are direct questions intended to stimulate class discussion. However, if the instructor indicates, the answers may be written.

Other types of questions may appear from time to time. When this is the case, directions will be given for their use.

unit A

THE APPRENTICE ROOFER AND HIS TRADE

A journeyman roofer has skills and knowledge of many kinds. Particularly important are the following: (1) he is informed about roofing materials; (2) he knows how each kind of roofing material should be applied; and (3) he has the skills used in applying these roofing materials. He has acquired these skills from his on-the-job training as an apprentice. He has become increasingly proficient in using his skills as he has worked at his trade. He has become informed regarding roofing materials and the ways they are applied on roofs from the instruction he received as an apprentice. He has kept up to date by studying the printed materials regarding their products that are supplied by manufacturers.

This workbook is designed to give you, the apprentice roofer, the information you will apply as you learn the skills on the job. The journeymen roofers who have written the workbook have arranged the material in what they believe to be a practical order for learning. They have divided the content into units and arranged the units so that each one is based upon and grows out of the preceding one. However, because of local job requirements, the instructor's own experience in teaching apprentice classes, and the backgrounds of the apprentices he is teaching, an individual instructor may wish to vary the order.

A Glossary has been provided in the back of the workbook so that you may learn the meaning of each new trade term as soon as you encounter it.

Grouped in this first unit is the information designed to introduce you to your trade--its history, its scope, the necessary safety measures, and the employee and employer organizations that serve it. It also includes a topic to help you recognize the responsibilities you must assume as a craftsman.

In addition, you are reminded of the material you have learned from studying the Introduction to Apprenticeship. Particularly important to your understanding of your own place in the trade are those portions of the Introduction to Apprenticeship that comprise Units A, B, and C.

Topic 1— HISTORY AND SCOPE OF THE TRADE

Introduction

The apprentice is generally interested in the trade he has chosen to the extent that he wants to know its history. And as you study this history, you will begin to learn something of the scope of the trade. Your knowledge of the two will give you a background against which you may determine the opportunities that become available to you as a journeyman roofer.

Related Information

Shelter. From the very beginning, man's survival has depended upon his ability to get the food required to sustain life and the protection required to keep himself from destruction by the elements or by enemies. Since primitive man had none of the skills required for producing food, nor any of the skills required for developing the needed protection, he had to depend wholly upon his environment for the food he ate and the protection he secured. He found that caves were his best shelters and began living in them.

From this time on man began developing skills that he could use in making things he needed. At the same time he began wandering over wide areas. Probably this took him into areas where there were no caves and he had to seek some other kind of shelter. The simple skills he had acquired were used for this purpose. The shelters were simple. They were built with the materials made available by nature. Some were built in trees, made of the branches that had fallen and covered with leaves and grasses that could be gathered easily. Others were hutches built on the ground and roofed with grasses and brush. Later, some were formed with branches and covered with the skins of animals he had found ways to kill. The important point is that man began in these ways to build the shelters he needed.

At first man's progress in building shelters for his protection was very slow, but as time passed the rate increased. The shelters you see today tell you how far man has progressed. The rapidity with which changes are being made in the shelters being built tells you also that you may see great improvements in the future. These improvements will include roofs that are designed to meet particular weather situations, constructed of new and unusual materials, attractive beyond anything now available, and in other ways expressions of the know-how and skills that man has at his command.

Roofing materials. A few points are presented here about roofing materials that have been widely used in both past and present.

- An example of a material used very early in history and still common in some parts of the world today, though not in this country, is the weeds and grasses used for thatching. Historically, they were easily obtainable and low in cost.

- Tile, slate, lead, and copper as roofing materials date back thousands of years. Some roofs of these materials have lasted for 600 to 1000 years. All these materials are still used to some extent, and particularly tile, which is one of the most durable available today.

- Wood roofs came into general use around 1700 and are still considered as modern as those made with more recently developed materials.

- Coal-tar pitch and asphalt products make up probably 90 percent of the roofing materials used today.

- In recent years, many new coating materials for built-up roofs have been developed. Examples are plastics, epoxies, and fiber glass. These materials are particularly adaptable to unfavorable conditions and to designs on which this type of roofing was previously difficult or impractical. Their development has made it possible for architects to introduce such designs as thin-shell concrete molded roofs, conical roofs with epoxy coverings, serpentine roofs, and the like.

Roofing methods and equipment. As materials have changed, so have methods and equipment. Years ago, for example, asphalt was heated by wood; later fuel oil became the primary source of heat; today butane gas is the main fuel used in most areas.

The methods of lifting asphalt to the roof have also undergone changes. At one time, the only method of hoisting was the rope and wheel. Although this procedure is often still followed, many roofers have added a pump to the kettle and pump asphalt directly to the roof. As roofers have found that their kettles are not large enough to meet the demand, some have turned to the use of tank trucks to supply hot asphalt directly to the roof.

Apprenticeship in roofing. Every skill or craft requires a period of training. Sometimes this learning phase is called "apprenticeship," other times it is not. For example, many journeymen in the roofing trade are not aware that they served apprenticeships because they were not called apprentices. Some of them were known as helpers and others as "improvers." However, the fact remains that before they became journeymen, they had to learn the trade.

Before the depression of the early 1930's, men were trained on the job as they were needed. This training sometimes was a long process. When a man reached the point where he thought he knew his trade, he often had to leave his employer and hire out to another in order to be recognized as a journeyman.

During the depression years, when work was scarce, the few remaining journeymen trained few new men because no work was available. When World War II came, the need was suddenly great, and few journeymen were in the trade. To get the work done, employers used the kind of training that gave quickest results--that of teaching a man only one phase of the work. For example, some men were taught only how to apply composition shingles, others only built-up roofs, and still others only roofing tiles. This kind of training met the need during the emergency, but when that was over, the trade was left with a number of only partially trained men, or specialists.

The lack of well-trained, well-rounded journeymen has worked a hardship on employees as well as employers. The specialists are able to work only when the specialty they know is available. Today, the need is for journeymen who are qualified in all phases of the trade. Competition among roofing contractors has made low bids necessary. Material prices remain fairly stable, but labor costs can fluctuate according to the various problems encountered on the job and even, what is more important, according to the skill and knowledge of the workers. This has resulted in a heightened demand for skilled, competent journeymen on every job.

Scope of the trade. "Apprenticeship Standards for the Roofing Industry in the State of California" designates the scope of the roofing industry through the work training schedule for apprentice roofers.

Process	Approximate Hours
A. Built-up roofing (225 hours maximum time as kettleman)	2700
B. Composition shingles	450
C. Miscellaneous	1350
(1) Slate, tile, and rigid asbestos materials	
(2) Pipe wrapping	
(3) Enameling	
(4) Spray work	
(5) Dampproofing	
Total	4500

Channels for advancement. Many men who enter the roofing trade think only of journeymanship as their ultimate goal and do not realize the possibilities for higher positions. In the apprentice training program, of course, the primary aim is journeymanship. However, many other horizons lie within the reach of every journeyman, with just a little extra effort. The journeyman may become a foreman of a roofing crew, salesman or estimator for a roofing company, a superintendent of a roofing company, or a contractor. He may also become a salesman of roofing materials or equipment for a manufacturer.

Requirements for advancement. Entrance into any field of work beyond journeymanship requires additional qualifications and training. Courses are available in the public schools and in correspondence schools in which the journeyman can gain technical knowledge additional to that he acquired during his apprenticeship. Whereas the journeyman roofer possesses skills in the use of hand tools and equipment, as well as related knowledge, the good foreman also has the ability to lead men. The superintendent needs all these qualities plus a keen mind, a pleasing personality, a level head, and a good deal more technical information.

To become a salesman requires knowledge of selling methods, understanding of people, acceptable speech, knowledge of basic mathematics and some bookkeeping, and skill in reading blueprints. Roofing companies often sell many items indirectly related to roofing, such as siding, waterproofing, and insulation. These products, too, must be studied by the salesman. Usually information about such products is available most readily from the manufacturers. In most cases, a salesman of roofing products who is a qualified roofer is more successful than is a person without this qualification.

Usually a roofing contractor must obtain a license from the state, as well as from the city or county, or both, in which he operates. However, much more is involved in becoming a successful contractor than obtaining a license. A successful contractor is a good businessman; he knows business procedures, some business law, bookkeeping and cost accounting, and business organization; and he has all the qualities required of a good foreman, superintendent, and salesman as well. The training necessary for a roofing contractor is available in most evening schools or correspondence courses.

Many variations in roofing practices as well as differences in jurisdictions exist throughout the United States. Roofers who plan to change locations should find out what skills might be needed in the area to which they plan to move and should acquire these skills as soon as possible.

The ambitious journeyman has many doors open to him. By taking advantage of every opportunity to improve himself, he may feel real pride in his trade and may soon advance to higher goals.

Checkup

Lead has been used as a roofing material for thousands of years. 1. T F

Gaining skill in all branches of the roofing trade will add to the journeyman's security. 2. T F

Roofing contractors today prefer to hire specialists to do a particular job. 3. T F

Wood is the main fuel used for heating kettles. 4. T F

Material prices remain relatively stable while labor costs can vary because of skill and knowledge or lack of it. 5. T F

Journeymen can expect to advance readily without additional training. 6. T F

Every craft requires a period of apprenticeship. 7. T F

The United States entered World War II with an abundant supply of well-trained roofers available. 8. T F

A roofer should keep informed concerning new developments in his trade. 9. T F

Because of the many mechanical roofing devices now in use, a roofer needs less knowledge to engage in his trade. 10. T F

Topic 2— SAFE WORKING PRACTICES

Assignment*

1. Construction Safety Orders, Division of Industrial Safety, California State Department of Industrial Relations, Sec. 1514, 1615-16, 1620, 1675-78, and 1715-21.
2. Ladder Safety (Bulletin 121), Division of Industrial Safety, California State Department of Industrial Relations.
3. Safety Rules for Roofers (Bulletin 124), Division of Industrial Safety, California State Department of Industrial Relations.

Introduction

General safety practices for the building trades may be found in Construction Safety Orders and other publications of the State Division of Industrial Safety, as well as in the Introduction to Apprenticeship. Every apprentice should learn and employ these practices. Since the roofing trade is one of the most dangerous of the crafts, certain safety practices that merit special emphasis are discussed in the following paragraphs, and every roofer should become familiar with these practices and employ them for his own safety and the safety of those around him. Responsibility for maintaining safe conditions in the work area and working in a safe manner lies equally with the employer and the employee. The employer should make the provisions necessary to establish safe working conditions; the employee should put forth full effort to maintain the conditions established, and to follow safe work practices.

Related Information

Clothing. When working on a roof, wear high work shoes with rubber cleat or crepe soles and pants of sufficient length and suitable material to offer maximum protection to the legs.

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* For names of publishers and places and dates of publication, refer to the list of instructional materials at the back of this book.

When handling hotstuff, wear a shirt with long sleeves that can be buttoned securely around the wrists and leather gloves. Both the shirt and pants worn should be of heavy material that provides reasonable protection from burns.

On certain kinds of construction jobs, all workmen are required to wear safety hard hats. Even when there is no requirement of this kind, the workmen should wear such hats, for they give valuable protection when it is needed.

Roof work. Inspect the roof before getting on to it to make sure that is is strong enough to support the crew and material to be taken to the roof. Also decide what, if any, repairs have to be made before the new roof can be applied. At all times exercise such caution as is required to avoid hazards that result from the roof surface. If the roof is covered with ice, snow, or frost, exercise extreme caution.

When working on or loading a roof, keep in mind the points of a roof that will carry the greatest weight--ridges, hips, valleys, and areas over rafters--and use this information in deciding how the roof will be loaded and how it should be walked upon.

Exercise extreme caution when walking or working on the eaves of a roof to prevent becoming victim of a fall.

If you suddenly suffer from dizziness or have fear of falling, get off the roof and advise your foreman of the condition. Staying on the roof can be extremely dangerous to you and those with whom you are working.

When laying felt, mark and cut the felt as necessary to expose existing roof openings. A 3-1/2 ft. guard rail must be placed around the perimeter of each hole. (Construction Safety Orders, Sec. 1615.)

Precautions in handling hotstuff. Carelessness at any time and in any phase of roofing is dangerous and particularly so in the handling of hot asphalt or hot tar. Only workmen who have been trained in the proper methods of handling hotstuff should be allowed to handle it and these workmen should be required to employ the following safety measures:

- When carrying hotstuff, keep your eyes open and make sure to avoid all obstructions in your path. On the ground, a clear unobstructed path must be maintained between the kettle and the hoist. (See Precautions for the Kettleman.)

- Whenever a bucket of hotstuff is carried, hold it slightly away from your body and avoid swinging it. The bucket should not be filled to a point where the surface of the liquid is less than four inches below the top edge,

- Place carts, buckets, and highboys of hotstuff convenient to the mop man, but never where he may fall over them as he is mopping.
- In pouring hotstuff from one bucket to another, pour slowly and evenly to prevent splashing and flashing. Should the contents of a bucket flash, it may be extinguished quickly by placing a piece of roofing or other covering over the bucket. This will immediately smother the fire.
- When filling a bucket from a highboy or other device that has a spigot, keep one hand on or near the spigot at all times so that it may be turned off immediately in case of flashing. A handle extension may be used as a further safety measure.
- Do not carry more than one bucket of hotstuff at a time on roofs of 1/4 pitch and over. (This is a slope ratio of 6 in. vertical to 12 in. horizontal.)
- Use a hoist to lift hotstuff to the roof where asphalt pumps are not being used. Never carry hotstuff on a ladder. When taking a bucket of hotstuff off a hoist, use one hand to brace yourself. With the other hand, carefully guide the bucket to a safe landing on the roof, avoiding any swing that might cause splashing.
- Never walk on a sheet of roofing that has just been laid. The hot asphalt or pitch under it may still be in a molten state, allowing the sheet to slip and cause you to fall.

Precautions for the kettleman. A kettleman is responsible for the safe operation of the kettle and for employing practices in and around the kettle area that are essential to the safety of himself and others who must enter the work area. These practices are outlined in the following section:

- Always wear a long-sleeved tight-wristed shirt of heavy material and gloves when working around the kettle. If working with hot pitch, protect all exposed areas of skin with an approved protective skin lotion to avoid burns from the fumes.
- The space immediately around the kettle must be kept clear, also the pathway from the kettle to the hoist.
- Never leave a kettle unattended once it is lighted. If a flash fire or boilover occurs, or individuals who are not informed enter the area, an attendant should be on the job to take the necessary safety measures.
- The kettle must be kept clean. A dirty kettle is more apt to flash than one that is clean.

- When using a kerosene-fueled kettle, never loosen the tap under the fuel tank when air is under pressure and the burner is lighted. To do so may result in the kerosene spraying out with the further possibility of igniting and burning you and causing the hotstuff to flash.

- Chop the asphalt or pitch into small chunks which can be fed easily into the kettle. Feeding should be done carefully by lowering the chunks to the surface of the hotstuff before releasing them, thereby avoiding splash. Wear gloves when feeding a kettle to avoid being burned by hotstuff that is accidentally splashed.

- Keep the temperature of hotstuff below that of its flash point. Every material used has a slightly different flash point and care must be exercised to make certain that this point is not reached. Also, the bituminous materials being melted are subject to distillation at high temperatures and the gases resulting from over-heating will condense in the cooler surrounding air and fall on nearby objects. (See Unit E for specific precautions.)

- Be sure that the hoist used in lifting hotstuff to the roof is designed so that the bucket of dope may be raised without its hitting the wall of the building. Raise the hotstuff at a slow, steady pace and do not release the hoist line except as instructed by the workman on the roof.

- Never set a bucket of hotstuff at the foot of a ladder on the "out" side. If it must be set down near the ladder (in preparation for hoisting, for example) be sure it is under the ladder on the inside so no workman can accidentally step in it while descending.

- Always keep the kettle less than full, to avoid splashing and slopping over, and to secure better temperature control so that flashes may be minimized.

- When possible place kettle in a position where natural barricades can be utilized to protect from injury those who might enter the area unaware of the danger.

- Before lighting the burner, empty any water that may have accumulated inside the kettle. Foaming and boiling over will be avoided by this practice.

- Be sure the gallows frame of derrick used is an approved type (Construction Safety Orders, Sec. 1717) and is properly situated for safe operation from the ground.

- The kettleman should keep a bucket of water containing gunny sacks close at hand where he can grab the wet sacks in case of kettle flashing and lay them over the lid to cool the contents and smother the fire.

- Before filling the fuel supply tank, be sure the burner is not lighted.
- Before lighting a burner, make sure all fuel lines have been cleared of any obstructions.
- Never transport a kettle when the burner is lighted. The kettle should be fired up only on the job site, and the flame extinguished before the kettle is moved to another location. Before a kettle is moved, the hotstuff should be drawn off to the top of the tubes. It is good practice to avoid overfeeding the kettle prior to its being moved so that not so much of the hotstuff will have to be drawn off.
- Prior to each lighting, fuel tanks and lines should be inspected for leakage. This is especially important when using LP gas. Always protect the fuel lines and tanks from accidental damage when on the job.
- Tires on the kettle trailer should be inspected just prior to transporting to make sure they are in good condition. If they are found to be damaged or otherwise unsafe, they should be repaired or replaced before the kettle is moved. In addition, when transporting a kettle, make sure the trailer tracks the towing vehicle properly and that the trailer hitch and safety chain are both secure. A weaving kettle on the road creates a most dangerous situation.

Precautions for the mop man.

- A used mop that has not entirely cooled always presents a fire hazard. Every experienced roofer knows of cases where mops, long after use, have been fanned into flame, thus setting fire to the roof.
- Never leave used, uncleaned mops where they might cause fires. Even for short periods--such as lunchtime--place such mops in empty metal containers or mop buckets.
- At the end of the day, squeeze out all possible hotstuff from the mops and then flare the fibers by twirling the handle. The mop head will thus be cooled sufficiently for storage.

Miscellaneous precautions.

- Make sure there are two fire extinguishers of an approved type on the job, one on the ground and one on the roof where they can be easily reached. Dry chemical, carbon dioxide, or similar extinguishers are generally used on roofing jobs.

- Check all ladders for safety prior to use. Do not use ladders that are in a generally weakened condition or that have split or cracked side rails; broken, cracked, or missing rungs; or sharp edges or splinters. Always secure ladders against accidental displacement.

General safety rules for the use of ladders are listed in detail in Ladder Safety (Bulletin 121, Division of Industrial Safety) and in Construction Safety Orders. Every roofer should know these rules and follow them.

Checkup

According to the Construction Safety Orders, the maximum distance that the kettleman should be from a kettle that has no thermostat is 200'. 1. T F

The Construction Safety Orders specify that a roofer may carry two buckets of hotstuff on a roof with a 1/4 in. slope (6 in. rise in 12 in.). 2. T F

Two feet is the minimum lap permitted for a two-section ladder with a working length of 30'. 3. T F

According to the Construction Safety Orders, a mop bucket is the same thing as a carrying bucket. 4. T F

If the weather is unusually warm, the roofer is permitted to remove his shirt while working. 5. T F

A sheet that has just been laid with hotstuff may be insecure and slip under foot. 6. T F

The roofer is advised to put both hands on the bucket when removing it from a hoist line. 7. T F

If a bucket is not too full, it may be carried up a ladder. 8. T F

In the roofing trade, the largest percentage of reported accidents involves strains and sprains. 9. T F

More accidents are suffered by roofers while carrying hotstuff than while doing any other part of their job. 10. T F

Topic 3— APPRENTICE, EMPLOYER, AND PUBLIC RELATIONS

Introduction

Everyone needs to take pride in his work and feel that his trade is looked upon with respect. And the roofer should be a man who commands respect. He is practicing a trade that requires skill, that calls for extensive instruction both on the job and in the classroom, and that produces an item essential to every building.

But whether the public does indeed consider the roofer a man worthy of its respect depends upon whether the roofer is willing to accept the responsibility of being a man deserving such respect.

The roofing trade--like any other industry--is known by the accumulation of the actions of everyone in it, from the apprentice through the contractor. Thus, the picture that the public forms of the roofing trade is colored by the way each apprentice and journeyman in it learns his trade, works at his job, and conducts himself.

Beginning with his very first job, each apprentice must realize that he now has a three-way obligation--to himself, to his employer, and to the public.

This topic cannot teach him how he should conduct himself in the eyes of each of these groups. But because it is being written by men who have worked in the trade, it can offer practical suggestions to help guide him.

Related Information

Of prime importance to the apprentice is the question of how soon he will be entitled to higher wages. Much more is involved in this than just learning the mechanical skills of the trade. Not only is he judged on how he does the work, but also on his attitude toward his job.

The beginning apprentice cannot be expected to know how to carry out his work until he has had instruction. But he is expected to be a responsible workman from the very start. For example, he may not know what method is used to remove debris from a roof until he has been shown. But from the first time he goes on a roof he is expected to know that he does not dispose of debris by dumping it off the side of the roof without first making sure that a clear space below has been provided for it, and even then not if persons or property might be injured.

Likewise, the beginning apprentice is expected to know that he must exercise courtesy at all times. From the time he arrives on his first job, he should know--without being told--that roofing equipment is set up in a location that will be most convenient for the workmen and least inconvenient for passersby.

Also important is for the apprentice to practice cleanliness, both in his person and in his workmanship.

These three things--responsibility, courtesy, and cleanliness--are regarded by men in the roofing trade as essentials for a successful craftsman. And the apprentice who starts in his trade with these things in mind will stand a better chance of being regarded as an asset to his employer.

Suggestions for the beginning roofer.

- Help maintain a clean job site. If old scraps and discarded pieces are allowed to lie around on a roof while it is being worked on, the work of the roofers is slowed. Mop handles and the outsides of buckets, particularly the bails, should be kept clean. The best way to do this is to use a roofing knife to scrape off the asphalt or tar. Also, the paths followed by the roofers in doing their work should be kept open. These are chores that the beginning apprentice is often asked to handle.

- Provide service for the journeymen working on the job. One way is to make sure that clean drinking water is taken to the roof for those who are working there.

- Protect the public and its property through helping to erect barricades around equipment, to get the truck in a safe location, and to collect debris that might clutter up the area.

- Help get things in order at the end of the day. All equipment and materials must be collected before the crew leaves a job, and motors and materials must be covered to protect them from moisture. When equipment is left on the roof overnight, a felt or sheet of vinyl should be used to cover the motors.

- Assist in maintaining equipment. On the highboy, for instance, the spigots should be oiled and the wheels cleaned, and, before lunch and at the end of the day, the tanks drained.

- Take particular precautions with kettles and mops that are stored. Kettles should not be left under a shed, or mops on a roof where they could cause damage if they ignite.

- Be courteous. Remember that the good will of your employer's customers can be maintained through such courteous acts as notifying the occupants of a house to close their windows before spudding or other dust-producing work is done.

- Be dependable. If you accept a job, make every effort to be on time for it, or notify your employer if you must be late or absent.

- Do your best to cooperate with your foreman and fellow workers while you are on the job. Usually, you will find that several different methods may be used to do a job that is workmanlike and watertight. Many times, different foremen will have different ways of doing the same job. As an apprentice, you must follow the instructions of the foreman for whom you are working. But if you are wise, you will study each of the different methods you are taught, and when you are on your own, you will be able to choose for yourself the one you find best.

- Avoid profanity, intoxicants, violence, and horseplay of all kinds.

- Work constantly to improve your knowledge and skill in the trade. You will find that your job is a great deal more interesting if you try to learn about all phases of it. You will have plenty of time later to specialize. If you permit yourself to specialize too early in your apprenticeship, you will deny yourself the opportunity for a well-rounded training. If at some time in the future your specialty should suffer a cutback, you will not be able to get a job in another phase of the trade.

- Observe basic laws of cleanliness. For example, keeping your hands clean is important because it helps prevent infections. The waterless hand soaps are best because they will cut asphalt but will not crack your hands. Also important is regular changing of your work clothes. You should put on clean work clothes at least once a week, and when you are traveling to and from the job you should change into a clean set of clothes as a protection for your employer's truck and other equipment.

- Help protect your employer's future. As long as he is successful, you--as his employee--are assured of a job. Ways in which you can help are to:

  --work safely. Not only is this important to your own health, but also to your employer. Costly insurance claims lead to higher premiums and thus to increases in his bids.

  --handle trucks safely and courteously. Doing so will help avoid accidents, law suits, and high maintenance costs. By all means, keep your driver's license up to date.

--learn how to handle your employer's equipment properly. You can do much to hold down repair and replacement costs.

--keep your employer's truck in clean, workmanlike shape. His truck is actually an advertisement for him. Would-be customers tend to judge the quality of his work at least in part on the basis of the way in which his truck is kept.

--be particularly careful in handling spray equipment. Overspraying, spraying in high winds, or spraying just before a rain can lead to extensive damage to surrounding property.

These are only a few of the many guideposts you can follow in your trade. Undoubtedly many others will occur to you as you work to improve and strengthen yourself as a member of the roofing trade.

Checkup

The best way to clean asphalt off a mop handle is to use a(n) __1__ __2__.

1. __________

2. __________

The recommended material to clean asphalt from a roofer's hands is __3__ __4__.

3. __________

4. __________

On a highboy that is in use all day, the tank should be drained how often during the day?

5. __________

Group Discussion

1. What are some of the tasks an apprentice should be able to handle on his first job--in the shop? On the job site? In loading?
2. How can an apprentice help his employer hold down job costs?
3. In what ways can an apprentice help his employer develop good will?
4. What clean-up jobs can be taken over by an apprentice?

Topic 4— EMPLOYEE AND EMPLOYER ORGANIZATIONS

Introduction

A brief history of the labor movement and the background of employer organizations is given in the Introduction to Apprenticeship (Topic 4 of Unit A). Emphasis in the material given here is on the organizations directly affecting the roofing trade.

Related Information

Employee organizations. The United Slate, Tile and Composition Roofers, Damp and Waterproof Workers' Association came into being through the amalgamation of two organizations chartered by the American Federation of Labor: the International Slate and Tile Roofers Union of America, chartered in 1903, and the International Brotherhood of Composition Roofers, Damp and Waterproofers of the United States and Canada, chartered in 1906.

The amalgamated organization received its charter from the AF of L on December 17, 1919, under its present name. The organization is affiliated with the Building and Construction Trades Department of the AFL-CIO.

Employer organizations. The first organizations of roofing contractors were informal and usually grew up when contractors found they needed to band together in cases of emergency, such as the Chicago fire. In 1882, a formal organization called the Master Slag and Gravel Roofers of America was founded in Chicago. At the beginning of the century, another national organization, the Associated Roofers of America, was formed in Omaha. In 1911, these two organizations merged to form the United Roofing Contractors' Association, which, in 1948, became the National Roofing Contractors' Association.

Also in 1911, manufacturers of asphalt and coal tar pitch products organized the Prepared Roofing Manufacturers' Association. Out of this grew the Asphalt Roofing Industry Bureau, an information bureau of the industry. The Western Asphalt Roofing Bureau serves the same function on the Pacific coast.

The National Roofing Contractors' Association includes all phases of the roofing industry, but at present the majority of its members are specialists in built-up roofing. Its objectives are to disseminate to members information on trends in the industry; on improved methods of application, estimating, record keeping, and merchandising; and on specifications.

Roofing contractors have also banded together into local roofing contractors' associations. Their functions are similar to those of the National Roofing Contractors' Association, but are localized. Their principal purposes are the negotiation of the master labor agreement and the handling of problems in the area that affect the industry.

Master labor agreements. Apprentices as well as journeymen in the roofing industry are affected by employee and employer organizations. Wages, working conditions, and the so-called fringe benefits are negotiated, agreed upon, and put into writing by the employee and employer organizations. These are known as the master labor agreements. The agreements are limited to a definite period. When the time has expired, a new agreement is negotiated.

Provisions of these agreements--particularly the fringe benefits--vary from one locality to another. As a rule, fringe benefits include such things as health and welfare plans, pensions, and vacation or savings funds.

The health and welfare plan is a form of insurance for paying hospital and medical expenses for the employees. Most of the plans in existence pay a certain percentage of all costs, leaving only a minimum to be paid by the employee. Many plans also include the dependents of employees. In most areas, plans are paid for by the employer after the employee has qualified.

Pension plans are set up to make monthly payments to employees who have worked at the trade a designated number of years, and who have reached a certain age and are no longer able to work.

The vacation or savings plan withholds from the employee's wages an agreed amount of money and places it in a fund under his name. Thus he can accumulate enough money for a vacation or for an emergency. Withdrawals from the funds are regulated so the employee cannot exhaust his savings. Some funds allow one withdrawal every 12 months, others every six months.

Joint apprenticeship program. In addition to the master labor agreements, the establishment and maintenance of an apprenticeship program in the roofing trade is also a joint effort of employee and employer organizations.

Recognizing the need for appropriate and complete training and education for young men desiring to enter the roofing trade, the United Roofing Contractors' Association and the United Slate, Tile and Composition Roofers, Damp and Waterproof Workers' Association were instrumental in the development of the apprenticeship program in this trade. In an effort to establish trade training for apprentices in accordance with the recommendations of the Federal Committee on Apprenticeship, these national associations in 1945 established a national pattern for local apprenticeship standards in the roofing industry.

In 1956, these organizations formed the National Joint Apprenticeship and Training Committee for the Roofing Industry, which functions to "revise the original pattern standards as well as to establish minimum national standards for the industry to meet the everchanging techniques and new competitive materials introduced which have constantly increased the skills and technical knowledge required in the trade and the necessity for more versatile, thoroughly trained craftsmen, capable of a more economical, long-lasting, and perfectly executed job."* This national group cooperates in its activities with local groups also concerned with apprenticeship.

Checkup

The roofers' union is the __1__ Slate, Tile and Composition Roofers, Damp and __2__ Workers' Association.

1. ________
2. ________

The __3__ Roofing Contractors' Association was organized under that name in 1948.

3. ________

The agreements negotiated between employer and employee groups within the roofing industry are known as __4__ __5__ agreements.

4. ________
5. ________

Under these agreements, the health and welfare plan is an insurance that pays for __6__ and __7__ services.

6. ________
7. ________

The joint apprenticeship program is a joint effort of __8__ and __9__ organizations.

8. ________
9. ________

The __10__ of the two original unions for roofers took place in 1919.

10. ________

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* U.S. Department of Labor, Bureau of Apprenticeship, *National Roofers' Apprenticeship Standards* (Washington, D.C., 1956), p. 1.

unit B

INFORMATION FOR THE BEGINNING ROOFER

As a beginning roofer, the apprentice has much to learn before he can be considered a full-fledged member of his trade. Merely to be an able-bodied man reporting to a job site is not sufficient in this day of sharp competition. The sooner he can take his place as a working member of the crew, the sooner the apprentice will win the recognition that means steady income.

Apprentices are immediately assigned in every trade to certain beginning jobs. In roofing, this job is loading--loading the truck to go to the job and loading the roof to start the job. Therefore, loading is a subject dealt with in this unit.

In addition, a topic is included on the various types of roof structures. The apprentice is expected to be able to recognize each type and have some understanding of its peculiar problems. Fundamental parts of this study are the recognition of roof pitches and, later in the course, determination of roof areas. Therefore, the apprentice must have an understanding of basic mathematics before he can go far in his trade. For those who need such instruction, Unit D is provided in the Introduction to Apprenticeship.

Topic 1— TYPES OF ROOF STRUCTURES

Introduction

As you will soon discover when you begin to work on different roofing jobs, roofs can be built in any one of a number of structural types. Not only do they look different, but they have different structural parts. All have certain stronger points that are safer for loading materials and equipment, and all have some weaker points where weight should not be placed.

This topic includes sketches and descriptions of the more commonly used structural types, for both residential and commercial structures. It also presents information on roof pitches, which is fundamental to the trade.

Related Information

The discussion that follows is divided into two sections, one on residential structures and one on commercial and industrial structures. The same types of roofs are often used for both. The chief difference lies in the engineering.

In residential buildings, rafters or beams are used as the chief support for the roof. When the size of the building is too great, however, stronger supports must be used. For these, specially engineered and constructed steel web or laminated wood beams or trusses have been developed.

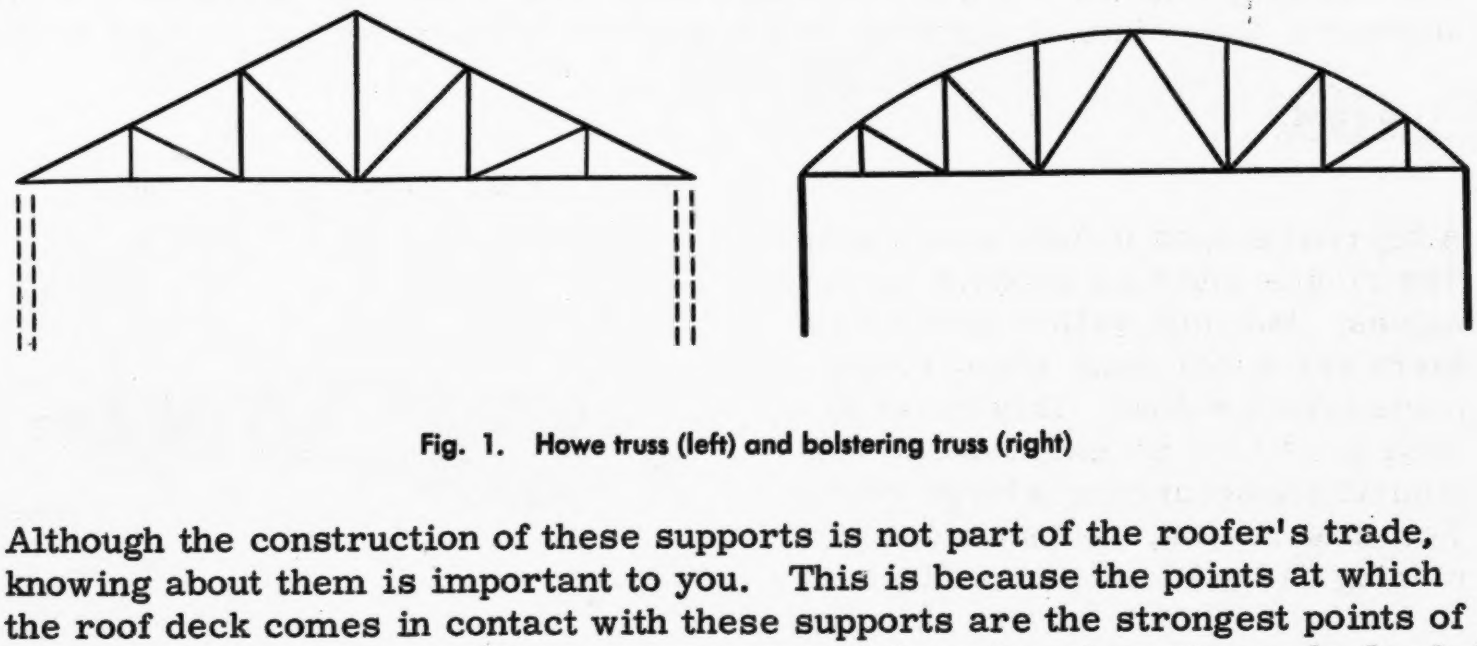


Fig. 1. Howe truss (left) and bolstering truss (right)

Although the construction of these supports is not part of the roofer's trade, knowing about them is important to you. This is because the points at which the roof deck comes in contact with these supports are the strongest points of the deck and thus are the places where materials and equipment may be loaded, and where you can walk most safely.

Another factor that is important in determining the load that may safely be placed on a roof is the material of which the roof deck is constructed. The deck may be made of a number of different materials, only some of which are strong enough to hold good-sized loads without danger. Decks that are particularly strong are those made of prestressed concrete, monolithic concrete (thick slabs), and metal.

On the other hand, on gypsum decks, thin-shelled concrete decks, and wood, plywood, and fiberboard (including thick fiberboard) decks, the weight of equipment and materials must be carefully distributed and not concentrated in only a few places. This does not mean that these decks are not strong enough to cover the buildings on which they are used, but it does mean that when the roofer loads such roofs, he should pay particular attention to placing materials and equipment over the beams or trusses. Likewise, he should not drop materials abruptly onto these decks.

Residential Roofs

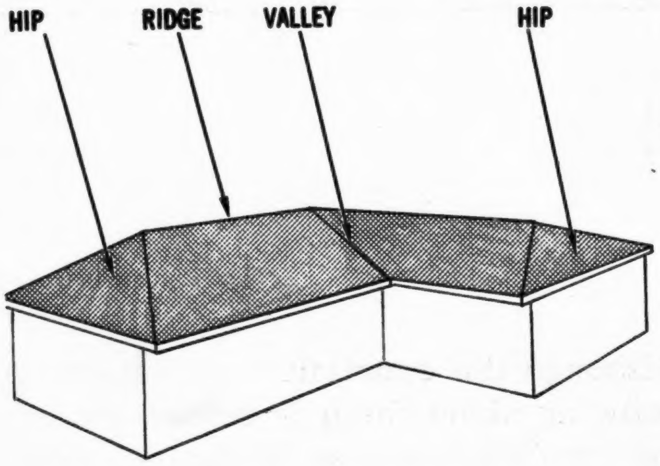
Many things influence an architect or builder's choice of type of roof structure. Certain house styles require related types of roofs. Weather conditions also play a part. For example, in snow country, roofs are usually built with a steeper pitch than are those in warmer climates. Personal preferences also enter into the choice, as do certain style trends.

You will also discover that not every roof consists of a single type of structure. Many, for instance, are combinations of hip and gable roofs.

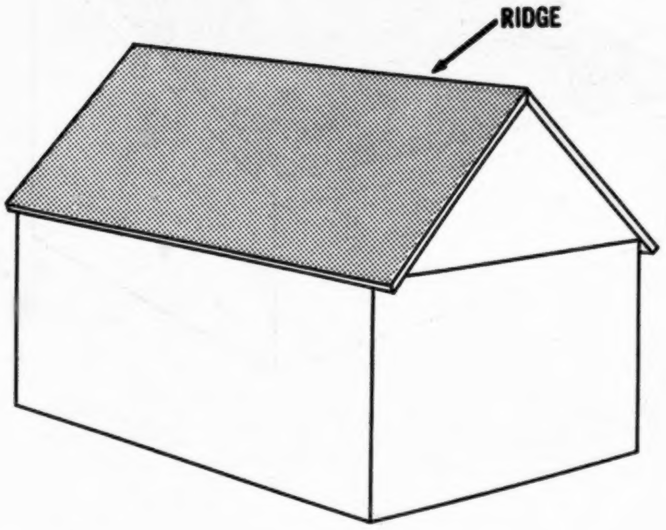
If a building with a pitched roof has more than one wing (see "Hip roof") or has dormers, the points at which the roofs of the wings intersect are called valleys.

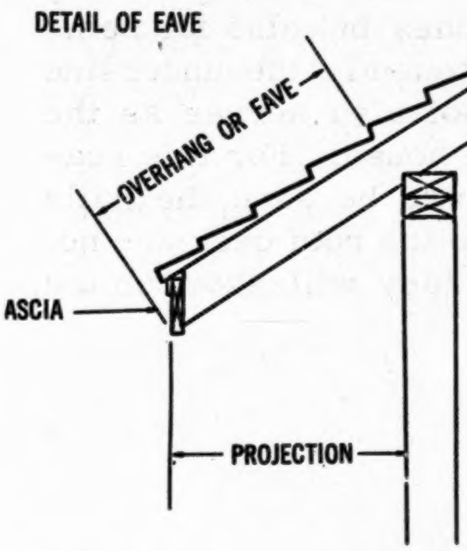
Hip roof.

A hip roof slopes in four directions. The ridges and hips support themselves, but the valley rafters (if there are such) must often be supported from below. This is not always possible because a valley will sometimes occur over a large room. For this reason, you should avoid placing heavy loads over valleys.

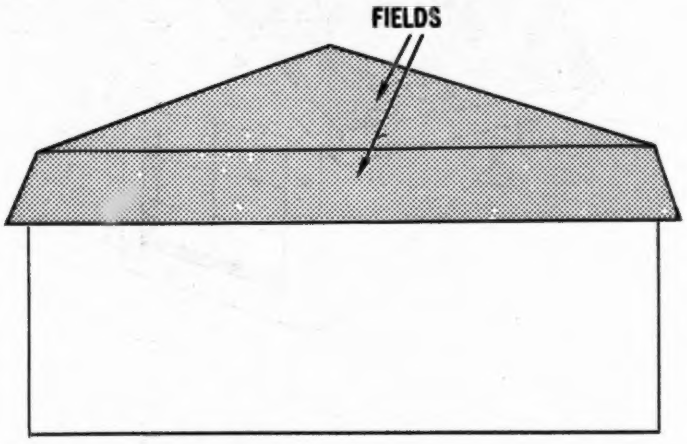


Gable roof. A gable roof is easier, cheaper, and faster to build than is a hip roof because it slopes in only two directions. The ridge is also its strongest point and the valley (if one is used) is weaker. As with all roofs, the eave, because it has no support, is the weakest part of the roof, especially if no fascia, or board, has been nailed onto the ends of the rafters.



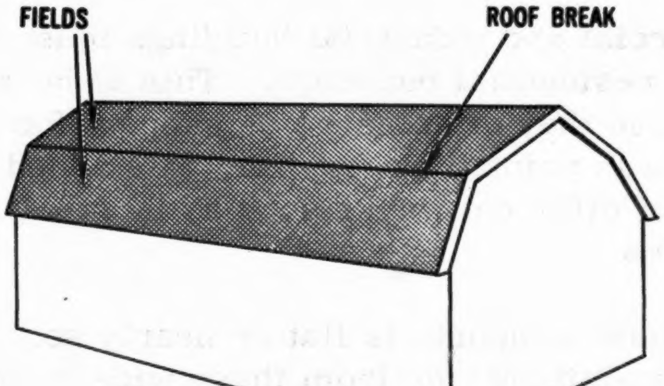


Mansard roof.



Like the hip roof, the mansard roof slopes in four directions. However, each slope is broken in the middle, as is the gambrel roof.

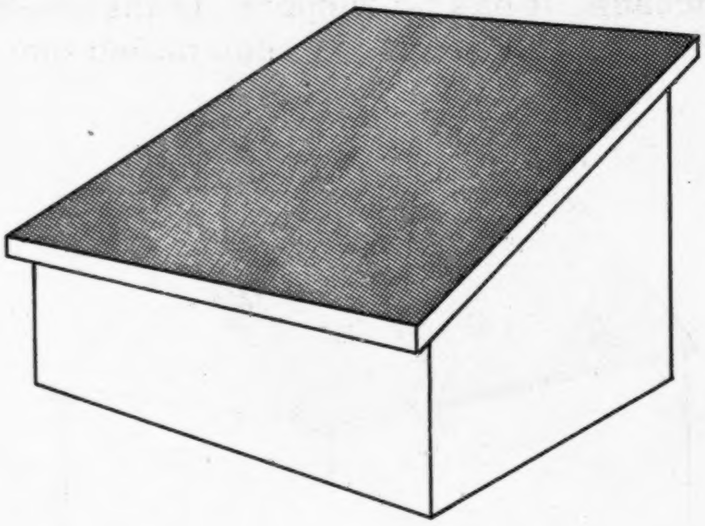
Gambrel roof.



Like the gable roof, the gambrel roof slopes in two directions, but each slope is broken in the middle to provide more living space under the roof. This type was developed in the United States in colonial times so the home owner could avoid the payment of a tax imposed on two-story houses.

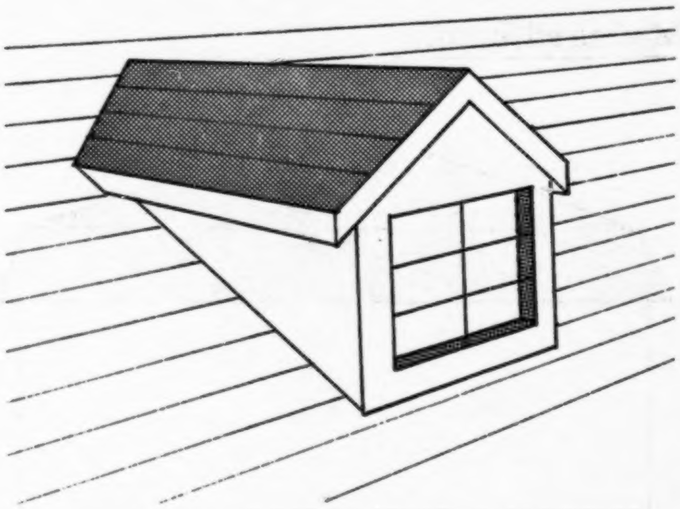
Shed roof.

The shed roof is also called a lean-to roof. It slopes in only one direction and is therefore an inexpensive type to construct. It is generally used for porches but also for some houses. Frequently the underside of a shed roof also serves as the ceiling of the house. For this reason, you should be sure the nails you drive into the roof deck are not so long that they will show on the underside.



Dormer.

The dormer is an addition to one of the other roof types. The dictionary defines it as a "houselike structure added onto a roof, providing space for windows or ventilation for the inside of the house." Dormers are used with pitched roofs, and at the point where they join, a valley is formed. Dormers are roofed at the same time as the rest of the roof.



Commercial and Industrial Roofs

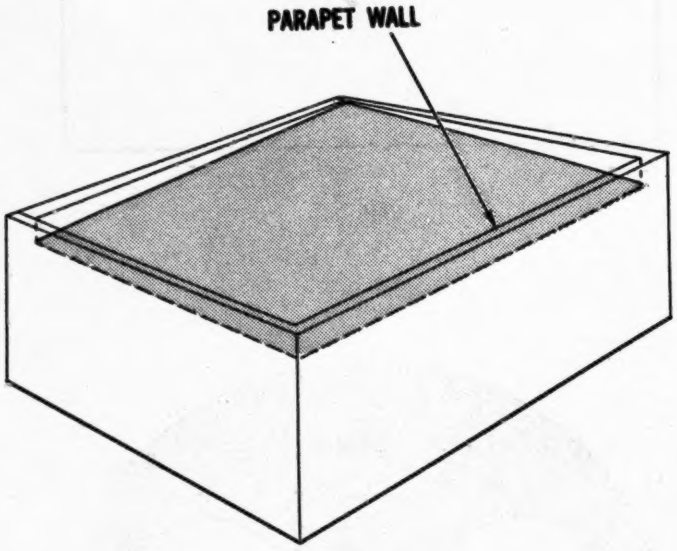
Flat roof. Roof structures over commercial and industrial buildings must be of stronger construction than those over residential buildings. This is because they usually cover wider spans and because they often serve as support for machinery and other heavy equipment. As was pointed out earlier, this added strength has been provided in a number of different ways, such as by steel beams, laminated wood beams, or trusses.

In many cases, the roof deck laid over these supports is flat or nearly so. Generally, provision must be made for draining water from these wide expanses. For this reason, the roof may be sloped slightly toward the center, sides, or corners where drains are located.

Commercial or industrial buildings in many cities are required by fire laws to be separated from other buildings by walls that extend some distance above the roof. These are called parapet walls. In addition, to prevent the spread of fire from one part of a building to another, firewalls are constructed from side to side within the building. These too extend above the roof deck.

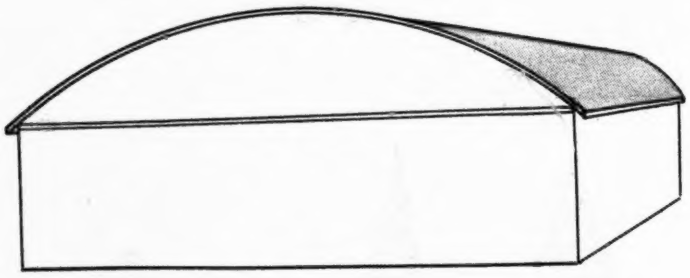
Of prime importance when loading a flat roof is distributing the weight, and insofar as possible it should be placed over the trusses or beams.

Flat roof.

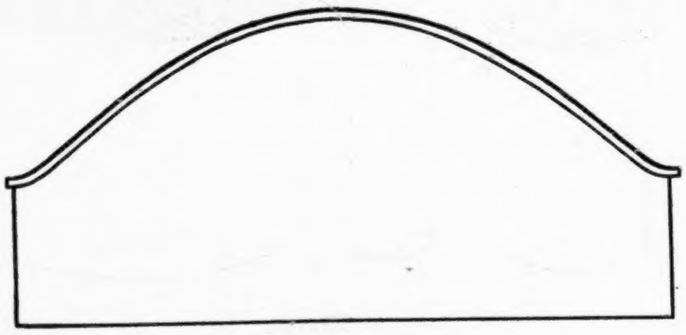


The extensive use of flat roofs on residences is comparatively recent, made possible through the development of asphalt to provide a watertight seal. Distributing the load over a flat roof is particularly important. The definition of a "flat" roof varies, but it is usually considered to be any roof surface with a slope of less than 1-1/2" in every 12".

Barrel roof and other variations.

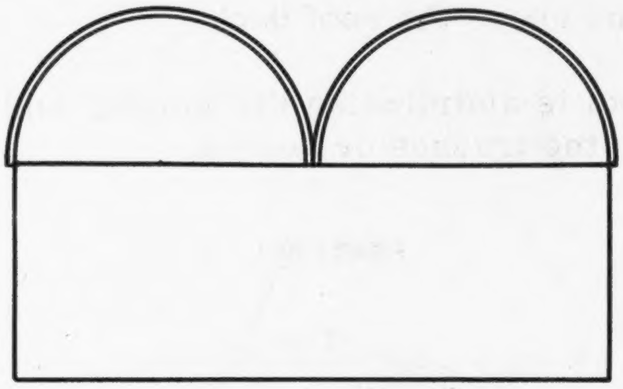


Because built-up roofing is the primary type of covering used on commercial and industrial structures, the slope cannot be too great. However, to take advantage of some of the truss shapes and to aid in drainage, commercial buildings often have a pitch great enough to be considered other than "flat." The barrel roof is an example of one of these types.

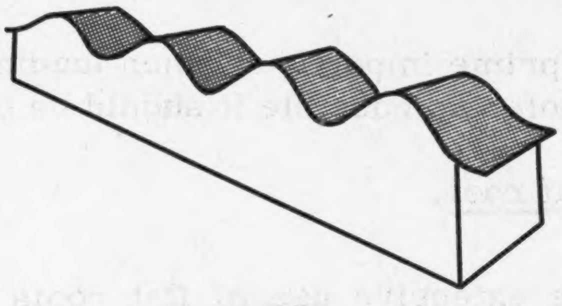


Another often-used type employs the metal or wooden tapered beam, which is engineered to give added strength. It can be turned so that the deck over it forms a low-pitched gable roof or it can be turned so that the top is almost completely flat.

Vaulted, serpentine, parabolic, domed, conical roofs.



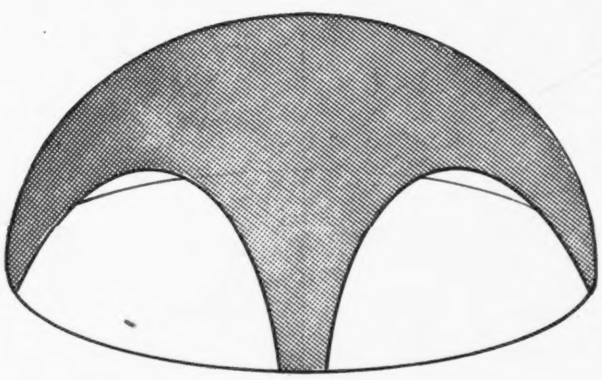
VAULTED



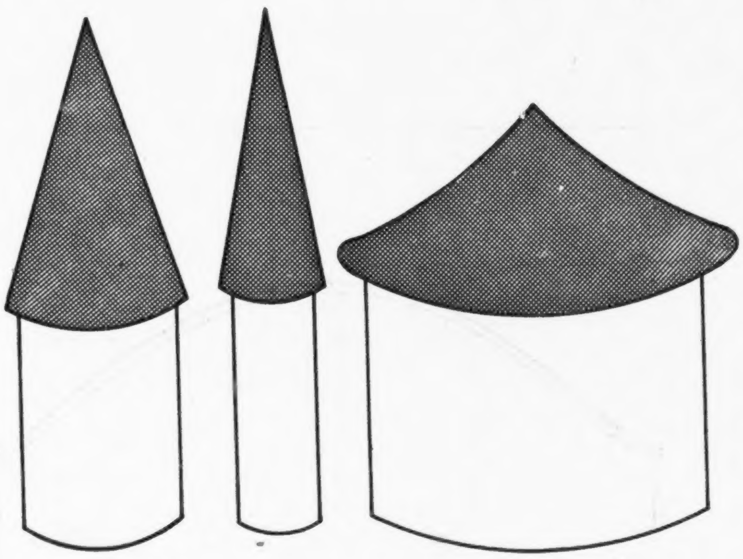
SERPENTINE

On occasion, you will encounter more unusual roof shapes, such as the vaulted serpentine, parabolic, and domed roofs. The use of epoxies is generally required because the shapes are such that built-up roofing materials cannot be applied to conform to the shape of the structure.

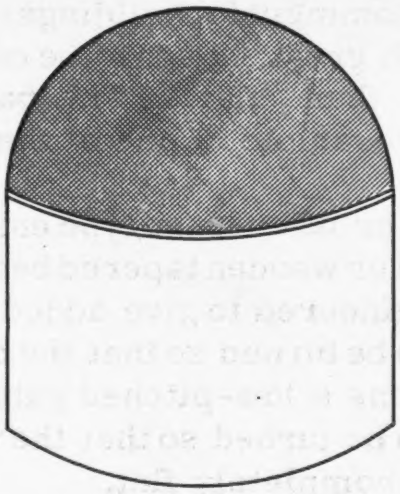
The church steeple is a good example of a conical roof. Composition shingles, slate, or tile are the most practical roof coverings. In many cases, these and related roof types cannot be worked on except from a scaffold.



PARABOLIC

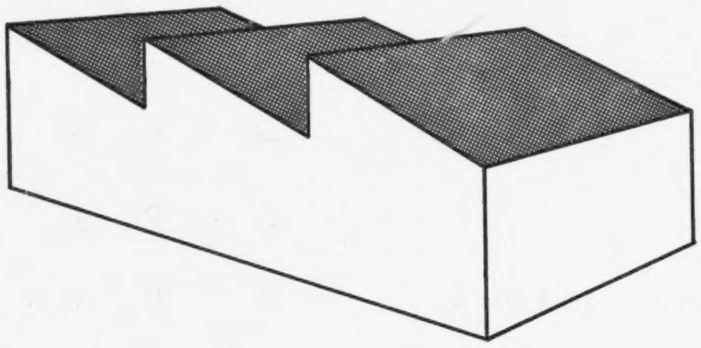


CONICAL



DOMED

Sawtooth Roof.



The sawtooth roof is used over industrial buildings to admit light from above. Windows are placed in the vertical part of the roof projection.

Essentially, each sawtooth is a shed roof and is treated as such. When roll roofing is used, it is often applied vertically because of the pitch. Drainage takes place through washbacks in both directions.

Pitch

Virtually every roof has a pitch, or slope, of some amount. As was stated earlier, if the pitch is slight enough, the roof is considered to be flat.

In the roofing trade, pitch is generally expressed as 1" and 12", 2" and 12" 3" and 12", or just as 1 and 12, 2 and 12, and so on. What is meant is that the roof rises the specified number of inches for each 12" that the run extends horizontally. Figure 12 illustrates these terms.

Span--total horizontal distance from lower end of one rafter to the lower end of the opposite rafter

Run --one-half of span (except on a shed roof or a roof with more than one pitch)

Rise--Vertical distance from the top of the plate the rafter rests on to the top of the roof

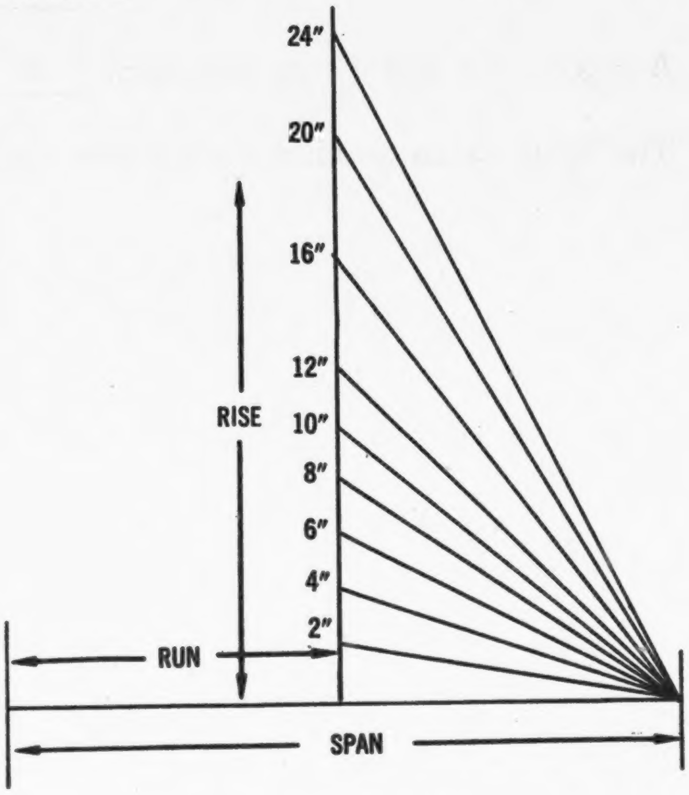


Fig. 2. Pitch terminology

Pitch may also be expressed as a fraction. This is arrived at by dividing the total span (twice the run) into the total rise. Thus, a 4 and 12 pitch may also be expressed as a 4/24 or 1/6 pitch. Likewise a 1/2 pitch is a 12/24 or 12 and 12 pitch.

Checkup

A hip roof slopes in only two directions. 1. T F

A shed roof is also called a lean-to roof. 2. T F

A gambrel roof slopes in only two directions and each slope is broken in the middle. 3. T F

On residential buildings, the chief support for roofs is provided by beams or ____4____. On larger buildings, steel laminated wood beams or ____5____ are often used.
4. __________
5. __________

On a vaulted roof, the roofing material generally used is ____6____. 6. __________

A roof pitch that is described as being 1/8 may also be described as ____7____ and 12. 7. __________

A pitch of 8 and 12 is also a(n) ____8____ pitch. 8. __________

A pitch of 6 and 12 is also a(n) ____9____ pitch. 9. __________

The fire walls around a roof are called ____10____ walls. 10. __________

Topic 2— LOADING THE TRUCK

Introduction

Usually the first job to which apprentice roofers are assigned is loading the truck preparatory to going on a roofing job. This is a more involved assignment than it may sound because the object is not just getting on the truck all the materials required, but also getting them on in the order in which they will be used and getting them arranged so their weight will be evenly distributed over all wheels of the truck. On the job the roofer should be able to lay his hands immediately on precisely the piece of equipment or material he needs.

You should also be aware that no workman should ride on the truck bed unless adequate seating is provided for his safety and comfort.

Related Information

Checking the Truck

Number one on the list of tasks involved in loading a roofing truck is checking the truck itself to be sure it is in good working order. Many a truck has been completely loaded and then found not to be operating--this is not only time consuming and costly but also very exasperating.

Therefore, before putting any equipment or materials on the truck, check it for oil, gas, lights, windshield wipers, tires, and the like.

Every truck should be equipped with a fire extinguisher, preferably of a powder type, and a first aid kit. Both should be checked regularly to be sure they are filled and ready for use.

A number of roofing contractors maintain different trucks for different types of jobs. In these cases, the trucks used for composition shingle jobs do not carry mops and buckets and the ones used for hot jobs generally do not carry roof brackets and planking.

Providing a specific truck for each type of job has definite advantages. Not only does it eliminate the need for transferring equipment from one truck to the other, but also it protects the materials and equipment. For example, a truck used for hot work may have asphalt spattered on the bed and sides. If shingles are loaded in the truck, they might become marked and spoiled by the asphalt drips.

Proper Loading

As pointed out earlier, a truck should be loaded with the job in mind. Therefore, the required materials and equipment should be loaded so they can be taken off in the order needed.

Before any equipment or materials are placed on the truck, the experienced roofer visualizes the job and figures out which materials and equipment will be needed first. These he loads on the truck last. However, you do not have this experience to rely upon and so this topic will attempt to point out what the proper order should usually be.

Built-up roofs. Built-up roofing, which is used on low-pitched roofs, is one of the major types laid. The list of materials for one such job might read: 14 rolls of 15-lb. felt, 20 lb. of 7/8 nails, 10 cartons of asphalt, 50 lb. of plastic cement, 20 rolls of 90-lb. cap sheet, plus tools and equipment. (For descriptions of roofing materials, see Topic 2 in Unit C.)

When the roofer arrives at this job, the first thing he must do is put the kettle into operation. Therefore, the asphalt should be loaded at the rear of the truck where it can be reached immediately upon arrival. Then, after the roof has been prepared, he will need the 15-lb. felt. Thus, it should be loaded before the asphalt.

Once the 15-lb. felt has been applied, the cap sheet is put on. And so it must be loaded before the 15-lb. felt.

Thus, you would load the truck in this order: The cap sheet, the 15-lb. felt, and, last, the asphalt. Because the quantities of plastic cement and nails required are small, they may be placed on the truck where they will fit.

Proper loading of a roofing truck involves not only determining the order in which materials will be used. Also important is placing the load on the truck so that its weight is equally distributed among the four wheels.

In the example given above, the cap sheet should be stacked in rows on end against the cab of the truck from sidegate to sidegate. Never lay this material flat, because doing so would make the rolls egg-shaped and might crack the material. If a row of cap sheet is short, complete it with the felt.

Next after the cap sheet, stack the 15-lb. felt on end. If the job requirement for felt is no greater than that in the example, the quantity of 15-lb. felt will not be large enough to require stacking it from side to side. Therefore, a good idea is loading such equipment as buckets and kegs on the left side and the felt on the right side.

If the truck is not equipped with racks to hold such tools and equipment as mops, brooms, and shovels, they should be put upright in or between the rolls.

Next, the asphalt--which is the first thing to be used--should be loaded. Place it from side to side against the 15-lb. felt and equipment. In most cases, the weight of the asphalt will hold the load in place. But if the load is very large, it should be secured with ropes.

Where ladder racks are not provided, ladders can be placed on top of the load or on the sidegate, but in either case, they must be tied to prevent them from falling off.

The last step in the loading process is hooking up the kettle. This connection is usually made with a ball trailer hitch or pin. Be sure the safety chain is connected every time you hook up the kettle going or coming from the job, and that the leg is raised before the kettle is moved. Remember also that the burner should not be in operation while in transit. Do not hang anything on the kettle. If a brake light connection is available, hook it up.

Composition shingle roofs. Because the variety of materials required for laying a composition shingle roof is not as great as that for a built-up roof, the order of loading materials for one of these jobs is not so important. However, when loading a truck for a composition shingle roof, be careful not to concentrate the shingles at the back of the truck. This could cause an excessive strain on the axle and result in a broken spring if the truck strikes a bump. The recommendation is to distribute the load equally from side to side and from back to front. Thus, its weight is shared equally.

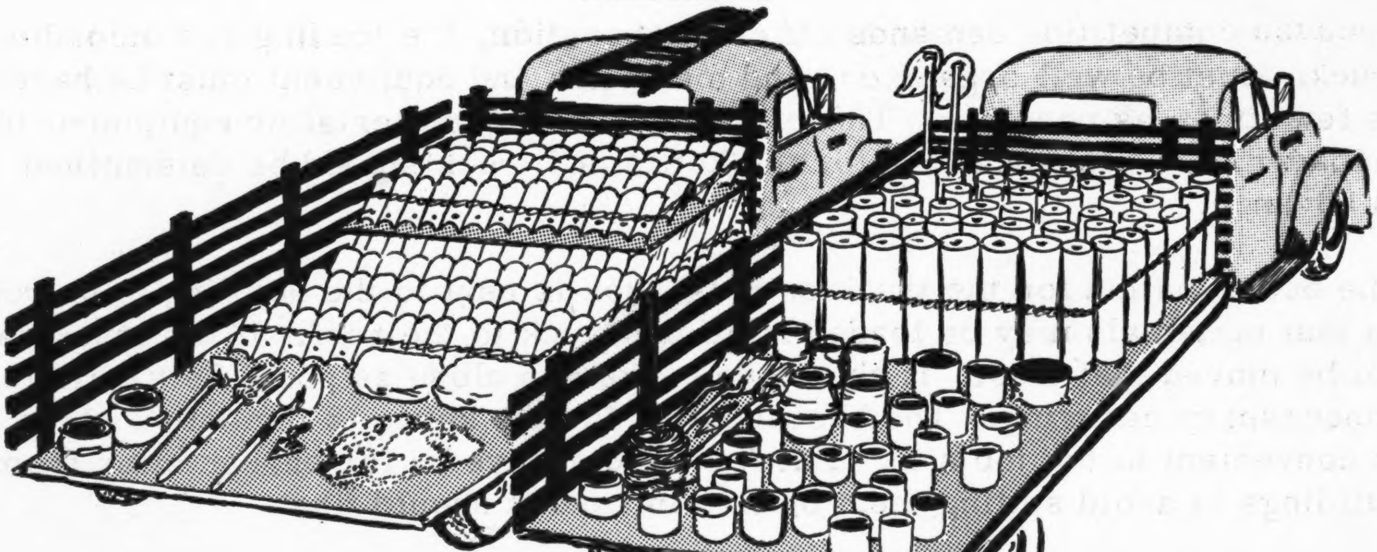


Fig. 3. Properly loaded trucks

To prevent stacks of composition shingles from sliding or toppling, the bundles should be alternated, a layer of three in one direction and a second layer criss-crossed on top.

Tile roofs. Although tile roofs are applied much less frequently than are built-up roofs and composition shingle roofs, the tile itself requires a great deal more care in loading and handling.

The major types of tile used for roofing are shingle, mission, and Spanish tile (see Topic 2 in Unit C for information on the types). All tile should be stacked on end and as straight as possible, to prevent them from breaking or cracking.

If Spanish tile has been designated, stack the field pieces in rows or tiers. Keep the rows even so that when loading is completed, a rope can be tied from side to side of the truck to secure the tile and prevent breakage.

Because of their fragile nature, the hip, ridge, and rake tiles may be placed on top of the rows to protect them.

Mission tile consists of tops and pans. They are of the same size and shape, but the tops can be identified by the hole in the small end, whereas the hole is in the large end on the pans. Both pans and tops should be set on the truck with small ends down, but they should be placed in separate rows on either side of the truck. Nest them with the open side toward the cab. Set them upright and lean the final four or five tiles against the upright ones so they serve to brace the rows.

Unloading

Because competition demands efficient operation, the loading and unloading of trucks must be well organized, and materials and equipment must be handled as few times as possible. Therefore, before any material or equipment is unloaded, the best locations for the kettle and truck should be determined in advance.

The best location for the truck on most jobs is next to the building to be roofed, so that materials may be loaded from the truck to the roof. If the truck cannot be moved that close, it should be parked as close as possible to eliminate unnecessary carrying. The best location for the kettle is the safest place that is convenient to the job site. But it should always be far enough away from buildings to avoid setting them on fire in case it should flash.

Although some contractors use fork lifts or lift-bed trucks to get materials to the roof, many contractors use various types of hoists or conveyors for this procedure. The following information applies to these cases.

If the truck can be left near the building throughout the application of the roof, many roofers prefer to leave materials on the truck until they are needed. However, if the truck has to be moved, the asphalt should be unloaded immediately (for built-up roofs) and placed conveniently near the kettle. The fire extinguisher should also be kept handy. Other materials should be placed near the roof-loading device.

The first thing placed on the roof should be the equipment needed for preparing the roof. Individual situations will alter the process, but, in general, materials are sent to the roof in the order in which they will be used.

For shingle roof jobs, after the placement of the roof brackets and planks (if they are required), shingles and flashings are taken to the roof and placed as outlined in Topic 3.

Loading for Return

When the job has been completed and the truck is reloaded for the return to the yard, trash should be separated. If the trash is stacked on top of leftover material and equipment, good materials or equipment may be thrown out with the trash. A common practice is putting the trash at the rear, and the tools, equipment, and leftover materials against the cab.

Be particularly careful in loading hot mops so they cannot come into contact with flammable materials, because a mop may start to burn at any time. When the truck is returned to the yard, the mops should be removed and the kettle disconnected and both put in a safe place at once.

Checkup

If assigned to load a roofing truck, the first thing the apprentice should check is the __1__. 1. ________

When a truck is loaded, the first things to be used on the job should be loaded __2__. 2. ________

Not only must the order of use of materials be taken into consideration in loading a truck, but also the __3__ of weight. 3. ________

To prevent stacks of composition shingles from toppling over, they should be stacked in layers of __4__, each layer crisscrossed. 4. ________

5. ________

Tile must be stacked __5__ __6__. 6. ________

Whenever the kettle is taken on a job, it is necessary to be sure the __7__ __8__ is connected.

7. ________
8. ________

For a built-up roof, the last of the roofing materials to be loaded on the truck should be the cartons of __9__.

9. ________

In mission tile, the pans have the hole in the __10__ end.

10. ________

Topic 3— LOADING THE ROOF

Introduction

As was pointed out in an earlier topic, loading roofs takes skill and a knowledge of the roof structure. Unless careful consideration is given to loading properly and safely, damage to the roof and to interior finish may result.

When loading a roof, consideration must be given to the strength of the roof deck, condition of sheathing boards, weight distribution, accessibility of material for application, and order in which materials will be needed.

Related Information

Checking the roof. A good workman will look over the roof deck before he loads any material on it, to determine if it will support the load. For example, cracked sheathing or sheathing with large knotholes may break under the weight of the material. Likewise, the overhang or eave should never have a load placed on it, and the roofer himself should exercise extreme care when walking or working on it. Among the things the roofer will look for is spacing of rafters and rafter supports so as to determine the parts that can carry weight. In cases where the rafter location is not easily determined, as in reroofing, the rafters can be located by tapping the roof until a solid pattern is found. Usually, rafters are placed every 16 or 24 inches apart.

Location for receiving. A location that will be accessible to all sections of the roof should be selected to receive the material from the ground. Probably as near the edge as practical and as near its center as possible would prove the best place if it could be used, because it would mean the shortest distance for distributing material to all parts of the roof. However, the location selected should be clear of obstacles that may be a hindrance in transferring material, such as skylights, dormers, valleys, or high fire walls.

Loading a pitched roof. Sketches of several different kinds of roofs are shown in Topic 1 to help you recognize the various parts of a roof and to give you an idea of the best places for loading materials. For instance, the strongest part of a gable roof is the ridge. The hips on a hip roof may also be used for loading. In addition, the support called a purlin that is usually placed midway between the ridge and outside wall at the eave may be loaded. Material should never be loaded in a valley because the valley has the least support of any part of a roof except the overhang. Nonetheless, the valley is still the safest place for the roofer to walk on a steep roof.

Loading commercial roofs. As a rule, roofs on commercial buildings are stronger than residential roofs, but care must also be taken in loading them. On flat roofs, the weight of the materials must be equally distributed over the roof. Although barrel roofs do not have a ridge, they are strongest along the highest part. In either case, the greatest part of the load should be placed over the trusses.

How to load. Sometimes, on large decks, the loading of the roof is done before the roofing crew arrives. The information given here is for these cases. However, at times the loading is done under the direct supervision of the foreman. Generally, the equipment needed for the job is placed on the roof even before the materials.

- Built-up and roll roofing materials

As a rule, material is loaded on the roof deck starting from the high point, with care taken to distribute the weight. If the material is loaded in one spot, the weight may cause the roof deck to collapse. The material that is to be used last, such as cap sheet, should be loaded at the highest point, thus eliminating the necessity of moving this material several times to apply the underlayers of felt. Felt should be loaded behind the cap sheet toward the low point. All roll roofing such as cap sheet and felt must be loaded in an upright position where possible. On steep roofs where this is impossible, rolls should be laid flat and parallel with the rafters. They should never be placed one on top of another because this causes them to lose their shape and makes them difficult to work with.

Under all circumstances, two fire extinguishers should be provided before the roof is loaded, one on the ground and one on the roof.

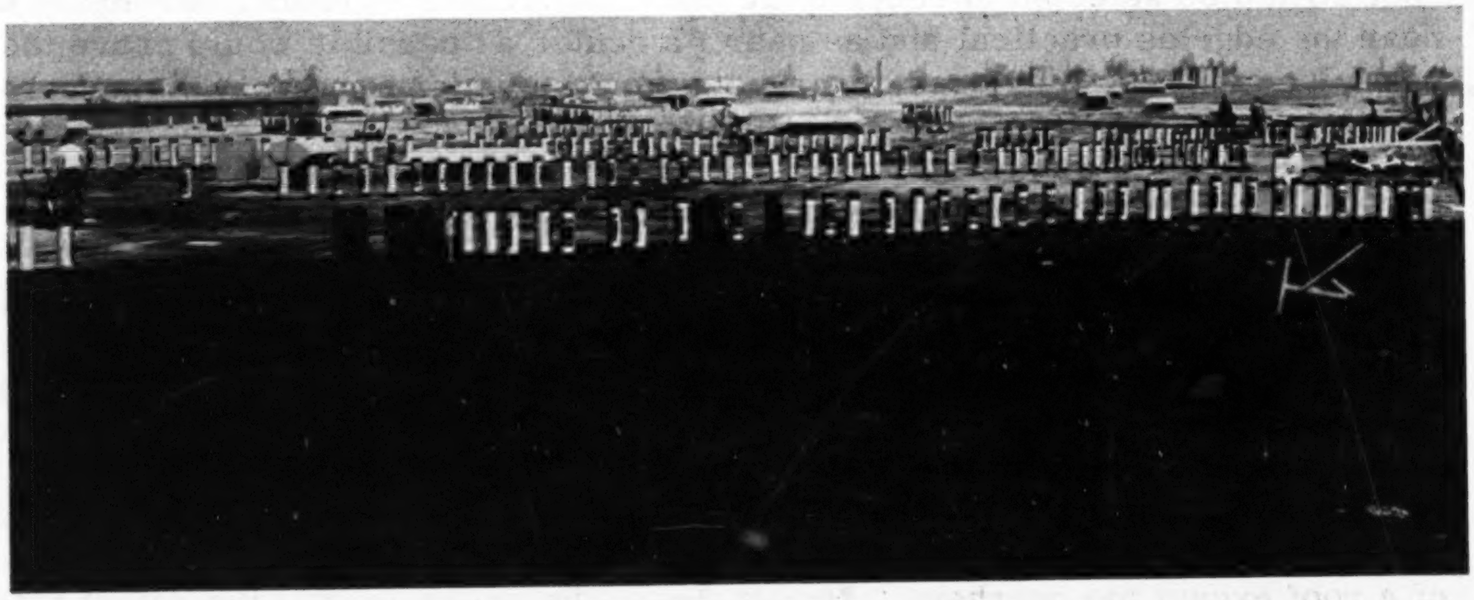


Fig. 4. A built-up roof in the process of application. Note the distribution of materials.

Gravel or rock should be loaded after the roofing felts have been applied, and sacks must be distributed to avoid placing too much weight in one spot. All material and equipment, including sacked gravel, should be set down carefully on the deck, never dropped. If they are dropped, damage may be done to the material, roof deck, structural members, and interior. Bulk gravel or rock is usually loaded only under the supervision of the foreman.

- Shingles

On one-story houses, composition shingles are very often loaded directly from the truck to the roof. When loaded from the truck, they should be placed beyond the overhang and then distributed along the ridge where the roof has more support and where the shingles will not have to be moved by the applicator. On higher structures, where loading directly from the truck to the roof deck is not possible, shingles are hoisted from the truck or ground by using an A-frame or ladder hoist. On steep roofs where shingles will slide, roof brackets and planking should be used to hold them. Remember, however, that a plank can only hold so much weight, and, if necessary, use several brackets and planks to hold the shingles.

Asbestos-cement shingles are loaded in the same manner as are composition shingles. However, because they are made of asbestos and cement, they are very brittle, and extreme care must be used when handling and loading them. They must be laid flat because if they are stacked on edge, damage may be done to the edges that would render them useless. Likewise, care must be taken not to bang the corners because they will chip off. If the shingles are stacked in tiers, three should be placed in one direction and the next three crisscrossed on top. Stacked in tiers, they cannot topple over. Placing strips of wood lath between tiers is also a good idea. Asbestos shingles have almost twice the weight of composition shingles; therefore they must be distributed more widely on the roof deck to equalize the weight.

- Tile

Loading tile on a roof requires a great deal of skill and is usually done under the supervision or instruction of a foreman or tileman. It is seldom done by a beginning apprentice and therefore will not be dealt with in this topic but will be explained later in the detailed discussion on tile.

Protection. In certain parts of the country, roofing materials must be protected against rain at all seasons. However, good practice usually demands that roofing materials in most parts of the country be protected against moisture. Coverings of felt, polyvinyl, or canvas tarpaulin, weighted with boards or other rolls, are used for this purpose. Under all circumstances, insulation should be protected from moisture, because it is particularly absorbent.

Checkup

Roof hips may safely be used for stacking roofing materials. 1. T F

If roll roofing cannot be loaded in an upright position, it may be laid flat but should be parallel to the rafters. 2. T F

Asbestos-cement shingles should be stacked on edge for safekeeping. 3. T F

Insulation should always be protected from moisture. 4. T F

The roof valleys are considered safe places for walking. 5. T F

Any location on the roof that is accessible from the ground is satisfactory for stacking roofing materials on the roof. 6. T F

The strongest part of a gabled roof is the __7__. 7. ________

On steep roofs, roof brackets and __8__ should be used to hold bundles of shingles that might slide. 8. ________

Material is usually loaded on a roof deck starting from the __9__ point. 9. ________

On roofs where the rafters are not visible, their location may be determined by __10__ the roof. 10. ________

unit C

MATERIALS, TOOLS, AND EQUIPMENT

Before an apprentice can progress far into the second phase of this program--how to apply a roof--he must be familiar with the materials and tools with which he will be working. He must be able to recognize each of them, know their specific purposes, and, especially in the case of tools and equipment, be aware of the hazards stemming from their improper use. These are the subjects dealt with in this unit.

The information is presented in six different topics. It begins with the importance of selecting the proper nails and using them correctly, continues through detailed listings of roof covering and other roofing materials, and concludes with discussions of the tools generally supplied by the journeyman and the equipment furnished by the contractor.

Many of the tools and much of the equipment used by the roofer are also used by other building trades. For this reason, the apprentice should study the material on basic tools presented in Unit E of the Introduction to Apprenticeship. The information in this workbook regarding the tools used in the roofing trade is planned to supplement--not replace--the discussion on tools presented in the Introduction to Apprenticeship.

Topic 1— NAILS AND NAILING

Introduction

Nailing is one of the first jobs given the apprentice roofer. And the apprentice soon finds that his work is judged not only by the speed with which he nails, but also by the skill and precision with which he drives nails into the deck. Nails that are improperly driven can cause roof failures, especially when they punch unnecessary holes in the material nailed or the heads stick up and fracture the material laid over them.

The roofer uses a shingler's hatchet or a straight claw hammer for driving nails. In all instances he should use tools of high quality and that are designed so that he can use them skillfully.

In some areas, nailing machines are being used by roofers. These machines can drive nails at a faster rate than any human nailer, but they cannot be used to advantage on all roofs, nor can they always be used to do all the nailing required on a roof. For example, they can be used efficiently on many flat, open areas, but not on small areas. They cannot be used on steep roofs, in confined areas, near edges, or against curbs.

Another innovation in the roofing trade is the use of staplers. Staples have now been generally approved for use in the application of some kinds of roofing. The stapler used, whether of the manual or pneumatic type, must be handled only by roofers who are skilled in the operation of these tools.

Related Information

Roofing nails. It is important that any nail to be used in roofing is intended specifically for roofing. The practice of using nails designed for any other purpose is wasteful because it will result in a job that has to be done over or that is easily damaged and therefore frequently requires repairs.

The holding power of a nail driven into wood results chiefly from the resistance between the wood fibers and the nail shank. For this reason, rough shank nails, such as galvanized nails, are generally used. And for this same reason, smooth steel nails are not used. Plywood roof decks do not have this holding power because the relatively thin layers of wood lack the resistance found in solid wood. A ring-shanked or barbed nail is therefore generally used in roofing over plywood decks.

Roofing nails made of different metals are available for use with the different types of roofing materials or to meet different requirements. For example, galvanized steel or copper nails are generally used to fasten tile or slate. The one used may be determined by the job specifications, or the requirements specified by the local building code, or if no specifications are available the contractor may use the kind of nail he finds most satisfactory and that meets code requirements. The roofer is rarely if ever called upon to select the nails used, but he should know why nails made of a given metal are selected for use on a specific job.

A bright steel nail--called a "slick"--will rust out rapidly if exposed to the weather; galvanized steel nails will last many years, even if exposed, and copper, brass, and aluminum nails will last almost indefinitely under the same conditions. Although these are important considerations, it should be remembered that most nails used in roofing are never directly exposed to the elements. In hot roofing, all nails used are covered with asphalt or felt, and in shingling, nails are covered by the succeeding layers of shingles. Even so, the nails are subjected to a certain amount of moisture and for this reason the rust-resistant qualities of the different kinds of nails should be considered in selecting the ones to be used.

Next in importance to the metal selected for roofing nails is the size of nail head. The larger the head, the more holding power it will have on the surface --provided the nail has been driven properly. The most commonly used head size for roofing is 1/2" in diameter. Properly spaced, this size will afford adequate holding power for composition roofing, including shingles.

When holding power greater than that of 1/2" nail heads is required, either capped nails or regular nails driven through the center of tin disks are used. These disks are usually 1" to 1-1/2" in diameter.

The length of the nail used is also an important consideration. One that is too short will not hold properly and may pull out, and one that is too long will project through the sheathing and thus create an undesirable condition. Therefore, both holding power and appearance must be considered.

In most cases, specifications will indicate the type and size of nail to be used. However, the journeyman should be informed to the extent that he can select the right nail length when job specifications do not indicate the nails to be used or so he can call attention to specifications that call for the use of nails apparently not suitable for the job.

Among the factors to be taken into consideration in determining the nail length is whether the underside of the deck is to be exposed, as the ceiling of a porch or patio might be. If so, the nails must not protrude through the deck where they can be seen from the underside. In all cases, however, it is best to use a nail short enough to avoid penetrating the deck on the underside.

The nails selected for a job must be long enough to penetrate the roof deck sufficiently to assure adequate holding power. In wood, this is usually considered to be 1/2". In reroofing, a special problem is faced in selecting the length of nails for the nails must be long enough to go through both the new and old roof and penetrate the deck by this distance.

To determine thicknesses of old roofing to be nailed through in reroofing, either find a raw edge that shows the depth of the old roof or cut a patch to determine the depth.

Nailing. On rolled roofing, the specifications will usually give the proper nail spacing for the job, such as 12 inches on center (12" o.c.), 18" o.c., and so on. When no specifications are given, the kind of material being used, the type of roof, and other prevailing factors will go to make this determination.

Driving nails properly requires long practice. In driving nails on a roof use sharp taps, not hard blows. The head of the hatchet or hammer should strike the nail head so that the "face" of the one used is parallel to the nail head so as to avoid bending the nail or slipping off onto and breaking the surface of the roofing. A nail driven in too far will break the surface of the roofing material and thus be useless for holding. Conversely, a nail that has not been driven in far enough to be "flush" with the surface, will not hold the material firmly and the nail head will also cut through the cover layer.

Once an apprentice has the ability to drive nails properly, he is then ready to start building nailing speed.

In nailing, most roofers use the "flip" method. They keep several nails in the hand opposite to that used for holding the hammer. As they need each nail, they turn, or "flip" the hand so that the back of it faces the roof deck and with the thumb push a nail, point down, between the two forefingers. They then tap the nail lightly with the hammer or hatchet to make it take hold enough to stand by itself, then remove the hand holding the nail before they drive the nail home. The rule of the nailer is "save the last lick," which means to withhold the last, final tap that would drive the nail past the point where the head rests snugly on the surface of the roofing.

Checkup

The roofer uses a(n) __1__ claw hammer or shingler's __2__ for nailing.

1. __________
2. __________

The nails used in applying a roof on a wood deck should be long enough to penetrate the deck not less than __3__.

3. __________

The most commonly selected nail head size for roofing is __4__ in diameter.

4. __________

The holding power of a nail is derived mostly from the __5__ of the wood fibers against the nail.

5. __________

When the material used on a roof deck offers less resistance than is offered by wood a __6__ or __7__ nail should be used to secure the holding power required.

6. __________
7. __________

In hammering roofing nails, the face of the hammer head should be __8__ with the surface of the nail head when the two meet.

8. __________

When additional surface holding power is required, __9__ nails are used, or regular nails used in conjunction with tin disks of __10__ to __11__ in diameter.

9. __________
10. __________
11. __________

As a general rule, nails should __12__ penetrate past the underside of a roof deck.

12. __________

If nails have not been driven so they are __13__ with the roofing, breakage may result in the __14__ layer.

13. __________
14. __________

In nailing, most experienced roofers use what is commonly referred to in the trade as the __15__ method of handling nails.

15. __________

Topic 2— ROLL AND SHEET ROOFING

Assignment

1. Strahan, J. L., Manufacture, Selection, and Application of Asphalt Roofing and Siding Products, pp. 1-9 and 11-14.
2. Manuals and catalogs published by manufacturers of various roofing materials.

Introduction

Each type of roofing material is made primarily for a specific purpose. However, certain materials have multiple uses. Knowing the materials and their uses will increase the apprentice roofer's value to his employer.

In this course roofing materials are presented in three topics. The first deals with the materials that form the various layers of a roof that are supplied in roll or sheet form, generally referred to as "flexible" materials; second, composition shingle and rigid types of roofing; and, third, other roofing materials used in the trade, such as adhesives and coatings, caulking compounds, flashing, insulation, and siding materials.

Related Information

Slip and Dry Sheets

Roofing should never be mopped solid to a wood roof deck because of the difference in the contraction and expansion of the roofing material and the deck upon which it is laid, causing the roofing to buckle, split, or crack. Dry sheets or slip sheets are therefore used to keep the new roofing material from being attached to the roof deck or previous roof covering. These sheets also prevent the asphalt or tar from causing damage inside the building being roofed by keeping it from reaching the sheathing and bleeding through it.

The weights of roofing materials are generally given in pounds per square (100 square feet). However, the weights of rolls of slip sheets are given in terms of full rolls.

The types of slip sheets most generally used are:

- 20-lb. (per total roll) rosin-sized sheathing, rolls 36" wide, contain 500 sq. ft. (5 squares)
- 30-lb. (per total roll) rosin-sized sheathing, rolls 36" wide, contain 500 sq. ft. (5 squares)
- 7-lb. (per square) saturated sheathing is an asphalt-saturated rag or wood-pulp-base paper roll, 36" wide, contains 500 sq. ft. (5 squares)

Felts and Synthetic Coverings

In the construction of a built-up roof, the main cover or base of the roof is made up of a number of layers or plies of felt that are held together by coats of asphalt or coal tar pitch. These are applied by mopping them on while the material is hot and rolling the felt on before the hotstuff sets. The cover sheet is applied on this base by using hotstuff as the cohesive agent.

Asphalt-saturated felts. Felts that have been completely saturated with asphalt either perforated or unperforated, are packaged as follows:

- 15-lb. felt, in 4-square rolls, 36" wide, 432 sq. ft., weight 60 lb. per roll; also in 3-square rolls, 36" wide, 324 sq. ft., weight 45 lb. per roll.
- 30-lb. felt, in 2-square rolls, 36" wide, 216 sq. ft., weight 60 lb. per roll.
- 40-lb. felt, a heavy rag felt thoroughly saturated and coated on both sides with a sand finish. It is furnished in 2-square rolls, 36" wide, 216 sq. ft. weight 80 lb. per roll.
- 53-lb. base sheet, in 1-square rolls, 36" wide, 100 sq. ft. Used in the application of cold process roofs.

Coal tar pitch felts. Coal tar pitch felts are similar in appearance to asphalt felts, but are saturated with coal tar pitch rather than asphalt. They must be applied with coal tar pitch. Asphalt cannot be used for it is not compatible with pitch. Coal tar pitch felts are packaged as follows: 3-square rolls, 324 sq. ft., 36" wide, weight 45 lb. or 15 lb. per square; 4-square rolls, 432 sq. ft., 36" wide, weight 60 lb. per roll or 15 lb. per square.

Asbestos felts. Asbestos felts are made of inorganic asbestos fibers which give it a greater life span than that of material made of rag or wood fibers. They are manufactured by similar processes. Asbestos felts may be used either as base sheets or as finish roofing. In either case, they should be applied with perforation dimples up so that gases or air trapped in the application will be released in the contraction of the felt. Brief descriptions of the most commonly used asbestos felts follow:

- 15-lb. perforated asphalt-impregnated asbestos felt, 3-square rolls, 324 sq. ft., 36" wide, weight 45 lb., used for built-up roofs of asbestos and of combination rag and asbestos. The perforations allow air to escape from underneath the felt at the time of application, thereby providing better bedding in the asphalt, which prevents buckling and blistering in the felt.

- 45-lb. asbestos-base felt, a heavy asbestos roofing felt, thoroughly saturated, coated on both sides with asphalt, and covered with sand. It is furnished in 1-square rolls, 108 sq. ft., 36" wide.

- 55-lb. asbestos-base felt, an extra heavy asbestos roofing felt similar to the 45-lb., and available in the same size rolls.

- 38-lb. two-ply asbestos felt, consists of two 15-lb. asbestos felts laminated together and used for base flushings. It is furnished in 1-square rolls, 108 sq. ft., 36" wide.

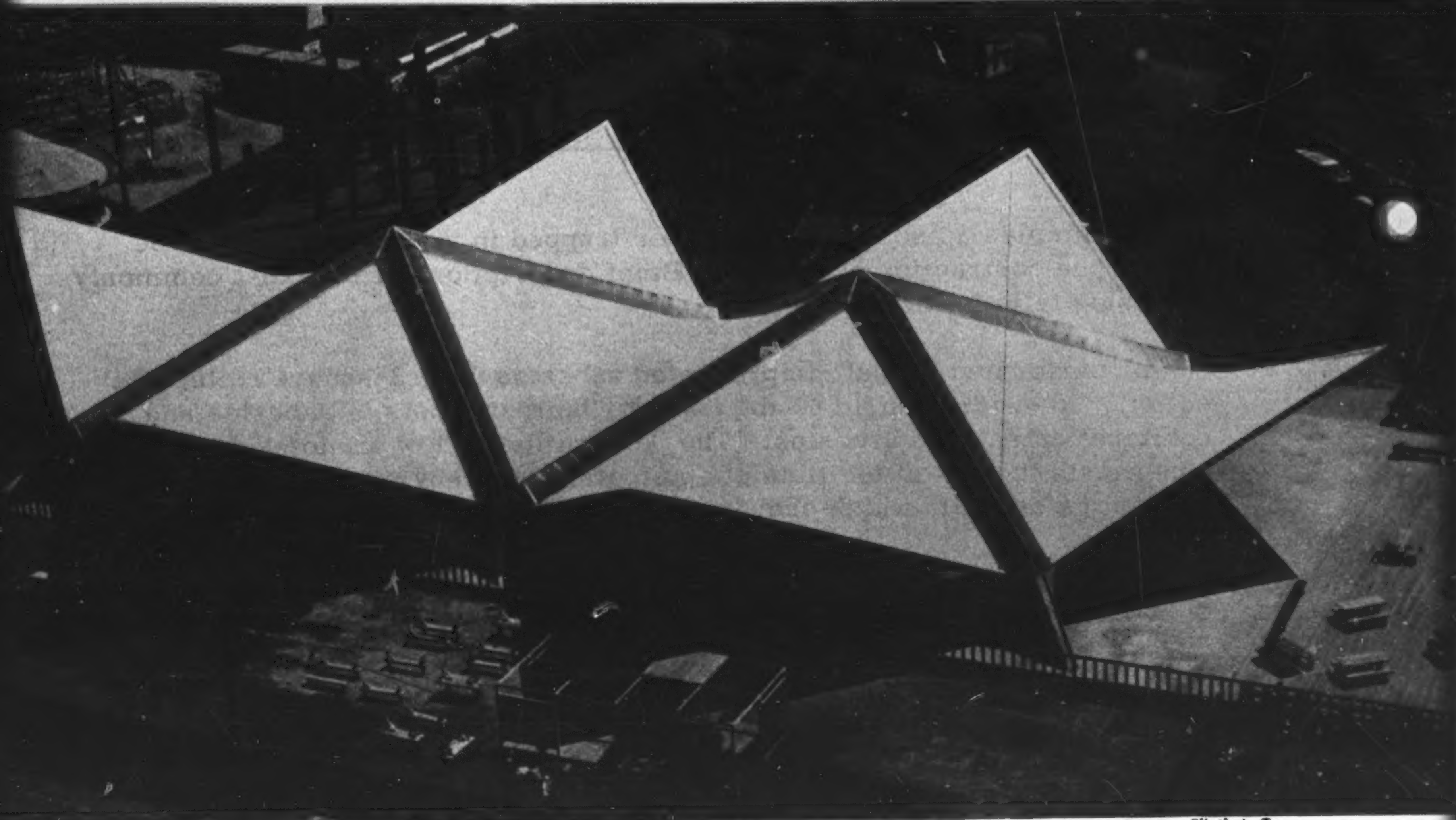
Fiber glass felts. In addition to the felts described, a further group of coverings has come into widespread use. These are made of glass fibers and are not "felts" in the strict sense of the word. The most generally used fiber glass materials are:

- Fiber glass base sheet, a mat of glass fibers, reinforced with continuous glass yarns, bonded together with a stable resin. It contains 12 lb. of asphalt per square. This material comes in 4-square rolls, 432 sq. ft., 36" wide and weighs approximately 62 lb.

- Fiber glass Perma Ply, trade name for a porus sheet of strong fiber glass reinforced with continuous glass yarns, bonded with resin, and saturated with asphalt. It comes in 5-square rolls, 540 sq. ft., 36" wide, and weighs approximately 46 lb.

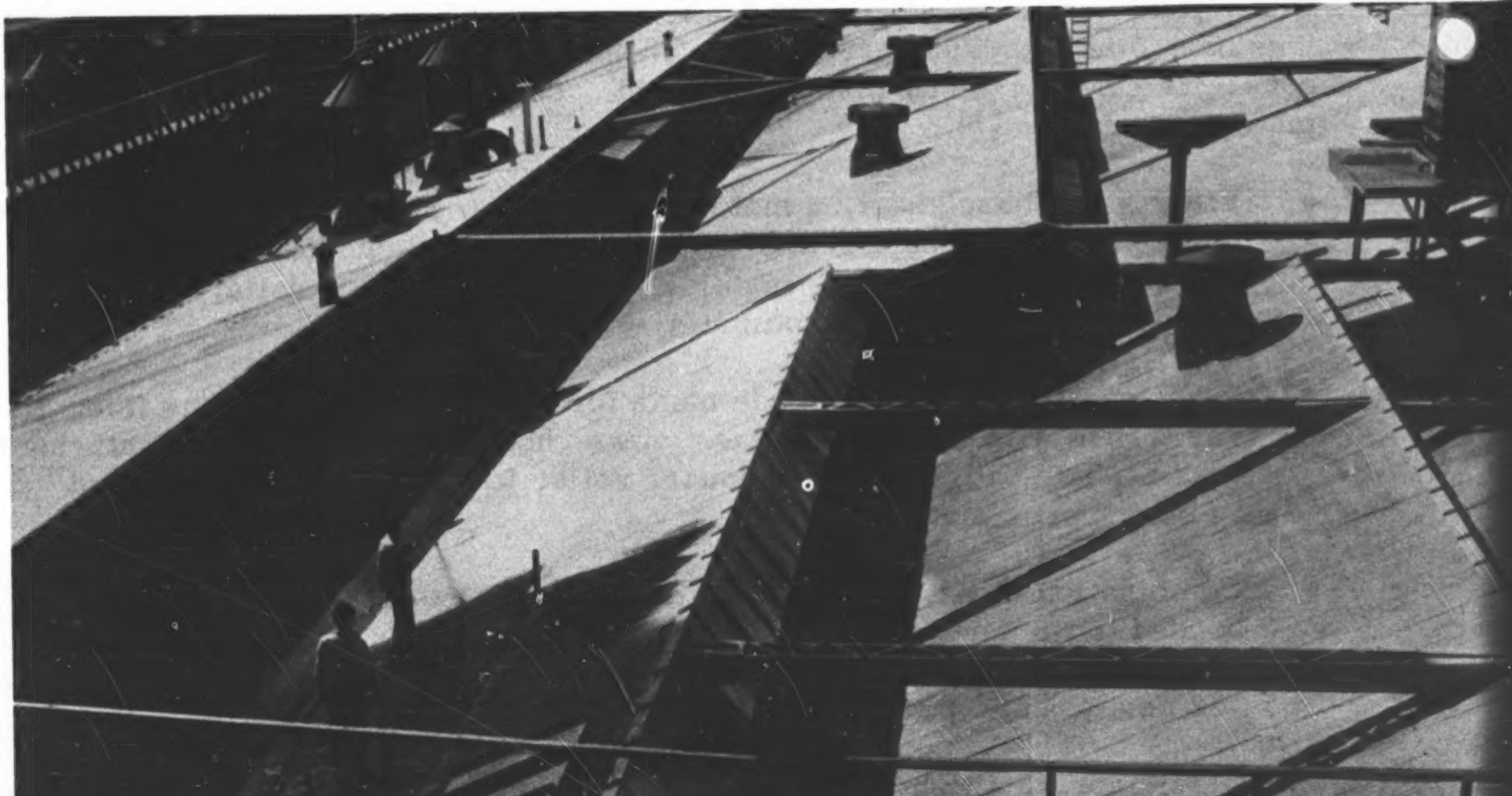
- Combination sheet, a fiber glass reinforced base sheet with kraft paper bonded to the face. It serves as both base and slip sheet in the application of Perma Ply or similar material. It is supplied in 4-square rolls, 432 sq. ft., 36" wide, and weighs approximately 62 lb.

- Glass fabric, a lightweight cloth woven from glass strands. It is manufactured in various widths. This fabric is often used as flashing material and certain kinds of reinforcement, as well as ply in built-up roofing and waterproofing assemblies.



Courtesy Flintkote Co.

Fig. 5. A roof covered with two layers of 53-lb. base sheet and one layer of glass cloth embedded in an adhesive, and then coated with a reflective white



Courtesy Flintkote Co.

Fig. 6. A sawtooth roof structure covered with one layer of 65-lb. felt, impregnated with a finish coat of reflective white

Cap Sheets

Cap sheets are finish saturated felts of different weights and with different surfaces. The following surfaces and weights of this material are the ones commonly used:

- 90-lb. mineral-surfaced cap sheet, an asphalt-saturated rag felt, coated on both sides, and more heavily on the side into which colored mineral granules are embedded. It is used for covering built-up roof assemblies and nail-on roofing. This material is furnished in 1-square rolls, 108 sq. ft., 36" wide, with 2" selvage, weighing approximately 90 lb. per roll. It is also used in certain areas in 77-lb. rolls, which contain 96 sq. ft.

- 105-lb. mineral-surfaced cap sheet, similar to the 90-lb. mineral surfaced, but with a heavier felt and a 4" selvage. It is furnished in 3/4-square rolls, weighing approximately 80 lb., 75 sq. ft., 36" wide.

- 45-lb., 55-lb., 65-lb., and 75-lb. cap sheets, heavy asphalt-saturated rag felts, coated on both sides, and dusted with talc, mica, or sand. They are furnished in 1-square rolls, 108 sq. ft., 36" wide, weighing approximately as designated.

- Flexstone mineral-surfaced roofing, a heavy asphalt-impregnated asbestos felt, surfaced on one side with mineral granules. Inorganic asbestos fibers are used in place of rag or wood fibers to increase the life span of the material. It is furnished in 1-square rolls, 36" wide, with 2" selvage and a shipping weight of 80 lb. per roll.

- Salamander White Top roofing, an asphalt-saturated asbestos felt cemented in manufacture to an unsaturated asbestos felt. It is used as a white cap sheet for asbestos built-up roofs where spraying or coating is not desired. This material is furnished in 1-square rolls, 108 sq. ft., 36" wide, weighing approximately 38 lb. per roll.

- Split sheet or S.I.S. (seventeen-inch-selvage), a heavy asphalt-saturated rag felt, 36" wide, 19" selvage, with 17" of exposed surface that is covered with colored mineral granules embedded in hot asphalt. It is used over built-up roofs where color is desired or where the pitch is too great for gravel. This material is furnished in 1/2-square rolls, 108 sq. ft., weighing about 58 lb., covering 50 sq. ft. of roof.

- Fiber glass mineral-surfaced cap sheet, a mineral-surfaced cap sheet for use over Perma Ply or combination sheet. It is an extra thick mat of glass fibers reinforced with glass yarns and bonded together into a tough sheet with a resinous binder. This material is impregnated and coated with asphalt and covered with colored granules on one side. It comes in 1-square rolls, 108 sq. ft., 36" wide, and weighs approximately 72 lb.

Roof Gravel

Gravel is often used in place of cap sheets as a finish material on built-up roofs. Like the granules in cap sheets, gravel helps prevent the evaporation of oils in the asphalt and felts. It also decorates roofs and reflects heat and ultraviolet rays, which are the biggest contributors to roof deterioration. Therefore, the light-colored rocks are often preferred. The maximum pitch on which rock roofs are practical is 3" and 12" where asphalt is used and 1" and 12" where coal tar pitch is used.

Coal tar pitch does not have oil in it, as does asphalt. Thus, the molecules of pitch, if protected by gravel or slag will, when exposed to the sun, tend to heal themselves and will never deteriorate. The only gravel used on pitch roofs should be hard and opaque and not less than 3/8" in size. The slag used should be graded from 1/4" to 5/8" in size.

While the term "gravel" is used to describe this material, it may have a number of different origins, often depending upon the resources of the particular area. The rock may be brought from the quarry, being only crushed and screened according to size before delivery, or it may be treated with a glaze and fired in a furnace before delivery. Among the quarried materials used are marble, gravel, and dolomite. In addition, a number of other materials are used on rock roofs. These include crushed china, crushed brick, and iron ore slag.

The materials used are usually delivered in bulk or bags. The materials should be free of dust and moisture. The more angular the pieces, the better they will embed themselves in the asphalt or pitch.

Checkup

Under certain conditions, recommended practice calls for mopping a slip sheet solidly to the roof deck. 1. T F

The only purpose of slip sheets is to keep tar from leaking or bleeding through the sheathing. 2. T F

7-lb. saturated sheathing is packaged in rolls containing 500 sq. ft. 3. T F

Asphalt-saturated felts are available in unperforated rolls only. 4. T F

30-lb. felt is furnished in 3-square rolls. 5. T F

The so-called rock roof is a form of built-up roof. 6. T F

Topic 3— COMPOSITION, RIGID, AND TILE ROOFING

Assignment

1. Strahan, J. L., Manufacture, Selection, and Application of Asphalt Roofing and Siding Products, pp. 1-9 and 11-14.
2. Manuals and catalogs published by manufacturers of various roofing materials.

Introduction

Most residential structures, as well as some commercial buildings, require a different type of roofing material than the roll or sheet type. This may be due to decorative considerations, climatic conditions, the shape of the roof or the slope involved. Usually, however, the slope of a roof will determine whether rolled or shingle roofing should be used.

The material most commonly in use today for residential purposes is composition shingle, since it is relatively simple to apply, comes in a wide variety of colors and textures, has a long life expectancy, and is comparatively inexpensive.

Asbestos-cement shingles are also popular and various kinds and shapes of tile are still in wide use, particularly in the western states. Slate is used very little.

Related Information

Composition Shingles

Composition shingles are an American product used in all parts of the United States, Canada, and Mexico. They are among the most popular types of roofing material and may be used on any type of roof with considerable pitch.

These shingles are available in three basic types: strip, individual, and interlocking. Composition shingles should not be confused with "diamond point" or "Gothic point" roofing with a shingle design edge, which is commonly referred to as nail-on roofing.

Nail-on Roofing

Nail-on roofing is also known as pattern-edge roll roofing, which in turn is known under many brand names. Diamond point and Gothic point are special designs of pattern-edge roofing.

Although nail-on roofing takes on the appearance of composition shingles, it has the advantage of a lower initial cost and is less expensive to put on because it is applied in long strips rather than short units like those of composition shingles. Nail-on roofing is single-coverage material and has a shorter life span than composition shingles.

Rigid Roofing

Even though the rigid roofing materials shed water, they are not waterproof. Therefore, the roof deck must have an underlayment. This varies from one layer of 30- or 40-lb. felt to several plies of 15-lb. felt mopped and coated with hot asphalt, depending on the pitch of the roof, before rigid material is laid.

Asbestos-cement shingles. Asbestos-cement shingles, as their name indicates, are made of cement and asbestos under pressure and are finished in grain or smooth patterns. They come in four basic styles--American, Dutch lap, hexagonal, and multiple-unit.

- American shingles are individual shingles, rectangular in shape. They are applied so that each succeeding course laps the previous one, thus giving double coverage. In coverage, they average about 226 shingles per square.

- Dutch lap shingles are larger than the American. They come in either squares or rectangles. Unlike the American shingles, they give only single coverage and are partially lapped at the head and one side. They average 113 shingles to a square.

- The hexagonal or French shingle is six-sided. Like the other types, it is drilled for receiving nails, but, unlike them, it is also notched on two sides to receive clips. Each hex shingle is lapped on two sides by succeeding shingles to give head coverage. These shingles average about 80 per square.

- Multiple-unit shingles look very much like American shingles when applied. However, they are produced in larger units so that each covers an area equivalent to that covered by several of the American shingles. This type averages 80 shingles to the square.

Asbestos-cement shingles weigh approximately 240 to 290 lb. per square depending upon the pattern. They come prepunched.

Tile. The primary types of tile used for roofing are shingle (or flat), Spanish, and mission.

The shingle tile is merely a shingle made of clay or cement. However, loading and application require a great deal more skill than for composition or wood shingles. Some forms are grooved for interlocking to help keep the tiles in alignment. The approximate weight of these tiles is 900 to 1500 lb. per square.

Spanish tiles some in single, complete pieces consisting of a curved top and a flat channel. When the tiles are applied, a flat channel is left between the curved tops.

Mission tile is similar in appearance to the Spanish tile. Generally, however, it comes in two pieces--pans and tops. When the single-piece mission tiles are used, the channel between tops is more curved than in the Spanish. The two-piece mission tile comes in a tapered or straight barrel pattern. The two-piece tile averages 1230 to 1330 lb. per square.

Portland cement in a mixture with sand is used in installing tile. Details on its mixture and use will be dealt with in the topic on installation of tile.

Slate. Slate used for roofing is a dense, fine-grained rock, quarried and slit into the desired shape and thickness, finished in either a smooth or rough texture. Slate roofing varies in thickness fron 3/8" to 2" and in length from 9" to 26". The widths vary in proportion. It comes in a variety of natural colors.

Checkup

American and multiple-unit shingles are similar in appearance. 1. T F

Asbestos-cement shingles come in two types--rigid and flexible. 2. T F

Pattern-edge roll roofing gives double coverage. 3. T F

Slate used for roofing is manufactured in much the same way as tile. 4. T F

Learning to recognize roofing materials and know their proper uses will __5__ the apprentice's __6__ to his employer.

5. __________

6. __________

Topic 4— OTHER ROOFING MATERIALS

Introduction

In this topic, adhesives and coatings, flashings, insulation materials, siding, and caulking compounds, the materials most commonly used in the roofer's work, are discussed. Once the apprentice roofer is informed regarding the materials that are available, he must then be constantly reading trade publications to keep himself informed, for new materials are continually introduced on the market and knowledge of them is essential to the roofer.

Related Information

Adhesives and Coatings

Asphalt. Asphalt, which is a by-product of the petroleum industry, is used to cement the different layers of built-up roofing together and also to embed gravel on a rock roof. When this product is to be used on a pitched roof, the melting point ranges from 135° F to 200° F; on a flat roof, the melting point can be lower. Asphalt is manufactured with stabilizers to prevent alligatoring when used as a top coating. It is commonly marketed in 100-lb. sacks and cartons, various sized drums, and large quantities may be purchased for delivery in tank trucks.

Coal tar pitch. Coal tar pitch, which as a by-product of soft (bituminous) coal, was the first adhesive used for roofing and is still used for built-up roofs with coal tar pitch felts and for the embedment of gravel for these assemblies. It is extensively used for waterproofing. Coal tar pitch is marketed in drums of various sizes.

Asphalt plastic cement. Asphalt plastic cement is a thick compound of asphalts, asbestos fibers, mineral stabilizers, and solvents. It is used for flashing and sealing and as an adhesive. It is marketed in one- and five-gallon cans and in 55-gallon drums.

Cold process cement. Cold process cement is very similar to asphalt plastic cement but is of a much thinner consistency. It is used for built-up roof assemblies. This material is marketed in one- and five-gallon cans and in 55-gallon drums.

Noah's pitch. Noah's pitch is a coal tar pitch product. It is used with coal tar pitch roofs as asphalt plastic cement is used with asphalt roofs. It is marketed in one- and five-gallon cans and in 55-gallon drums.

Asphalt emulsion. Asphalt emulsion, used as a protective coating on roofs and as part of waterproof membrane systems, consists of particles of asphalt suspended in water. It also is manufactured with asbestos fibers for greater bridging ability. One form of asphalt emulsion is available in a variety of colors. It is marketed in one- and five-gallon cans and in 55-gallon drums.

Asphalt primer. Asphalt primer is a thin solution of asphalt and petroleum solvents. It serves as a priming coat under built-up roofing, waterproofing, dampproofing, and other asphalt coatings on surfaces of concrete, gypsum, cinder block, brick, and metal. This material is generally brushed or rolled on with a roller mop. It can be applied with a small portable sprayer. It is marketed in one- and five-gallon cans, and in 55-gallon drums.

Rain patch sealer. Rain patch sealer is used to repair leaks in wet weather. It is composed of asphalt, asbestos fibers, and non-oxidizing minerals. It is marketed in cans of one to five gallons.

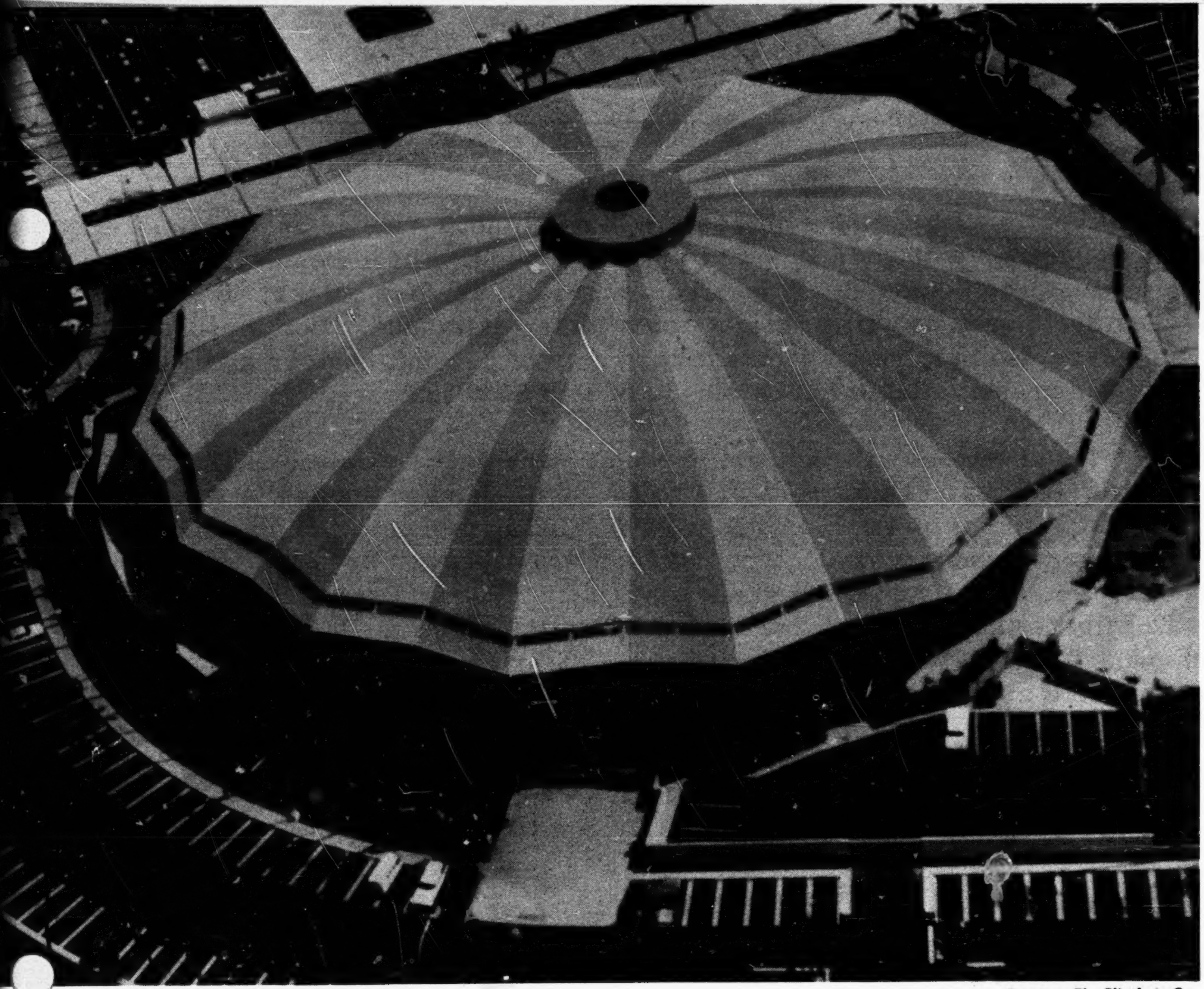
Aluminum coating. Aluminum coating consists of aluminum flakes suspended in asphalt roof coating and is used to protect roofing and to reflect heat. It is also manufactured to include asbestos fibers for greater bridging ability. This material is marketed in containers of 1 to 55 gallons.

Cut-back roof coating. Cut-back roof coating is asphalt that has been cut back (diluted) with petroleum solvents to a thick liquid. It is manufactured in two forms, plain and with asbestos fibers. This material is used as a protective coating, and one form of it is used as an adhesive. It is marketed in containers of 1 to 55 gallons.

Decorative coating. Decorative coatings are resin-based materials available in various colors. Their primary purpose is to waterproof a structure or object where color is desirable. These coatings come in the same size packages as aluminum coatings.

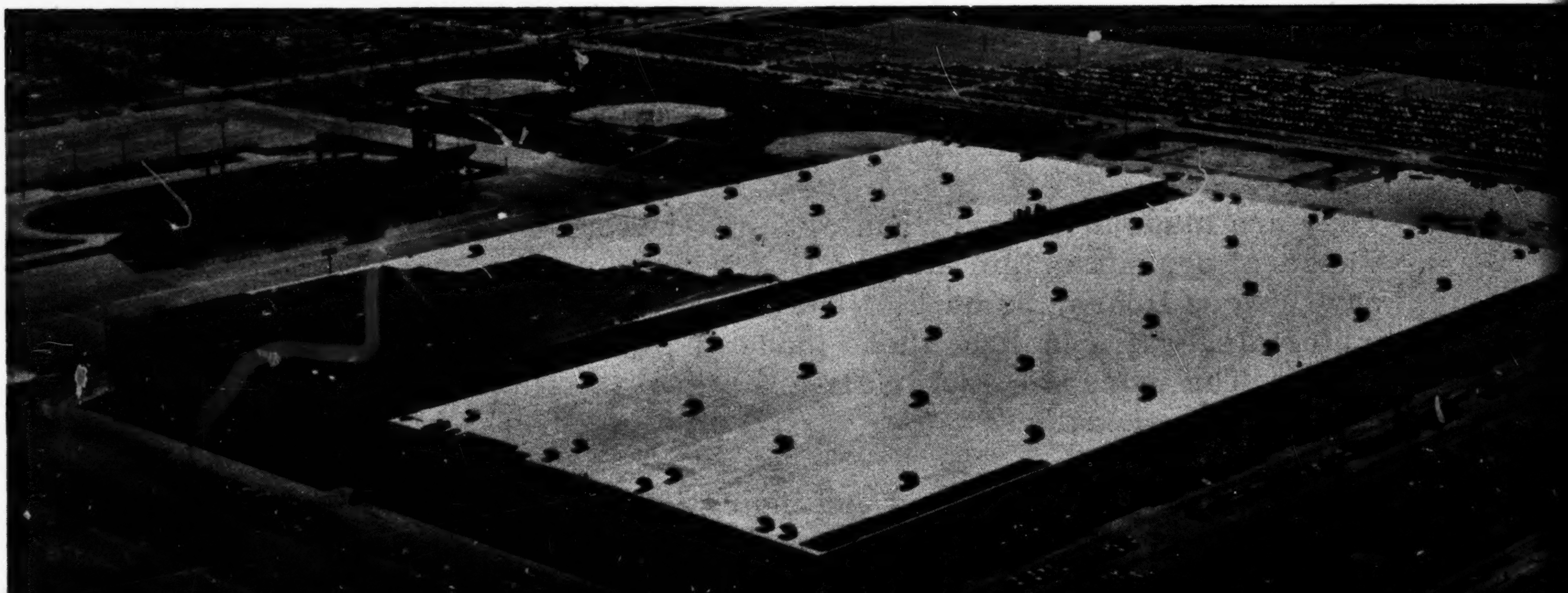
White reflective coating. White reflective coatings are used for appearance, for heat reflectivity, and for protection. These are made from vinyls, lime, and combinations of both. They are available in containers of 1 to 55 gallons.

Neoprene roof coating. Neoprene roof coating is a synthetic rubber coating that is used as a roof covering primarily as a base on wood to be covered by Hypalon. It is packaged in containers of 1 to 55 gallons.



Courtesy The Flintkote Co.

Fig. 7. A thin-shelled concrete roof covered with Monoform roofing system and coated with a reflective white. Behind the dome may be seen several flat roofs with built-up roof coverings



Courtesy Flintkote Co.

Fig. 8. A flat roof in the process of being treated with aluminum roof coating

Hypalon roof coating. Hypalon roof coating is a synthetic rubber coating similar to neoprene, with the exception that carbons have been removed, thus allowing pigments to be added. It is manufactured in various colors. Some of its features are elasticity, light weight, and flame resistance. Both neoprene and Hypalon are used to great advantage for roofs of unusual contour and odd shapes. Hypalon is available in containers of 1 to 55 gallons.

Monoform. Monoform is a three-part product. One part is plastic resin in liquid form (delivered in containers of 1 to 55 gallons). The second is a catalyst or chemical to set up the plastic, and the third is a glass fiber in long strips (packaged on large coils). The resin and catalyst are sprayed onto the roof deck at the same time as the glass fiber is chopped and spread onto the deck. The fibers thus serve as reinforcement to the plastic. The plastic may be compounded to suit the conditions at hand--for example, soft and resilient where expansion ability is needed. A special applicator that both sprays and chops is used with this material.

While Monoform is a trade name used by only one manufacturer, a number of variations are on the market.

Flashing Material

Glass fabric, cotton fabric, jute fabric, Irish flax felt, elastic flashings (synthetic rubbers), as well as most materials used in built-up assemblies are used as flashings. In addition, a number of different metals--galvanized iron, copper, terneplate, and sheet lead--are also used as flashings. These will be discussed more fully later in the course.

Insulation Materials

Insulation materials, which are applied under roofing felts, are used on roofs requiring thermal (heat) or sound barriers.

They are made of either organic (derived from plants) or inorganic materials. Those of organic origin are the fiberboards, which are made from sugar cane, wood fibers, or bark. They come in larger sizes than do the inorganic materials, which include those made of plastic foam, fiber glass, and spun rock. The inorganic materials are more satisfactory than the organic for use in damp areas.

In addition, both fiberboards and insulation made of glass fibers may be asphalt saturated to help protect them from moisture during their storage and application. Because the purpose of insulation is to insert a layer of dead air cells between a building and its roof, the materials are porous and thus most of them tend to absorb water readily if they are not kept protected.

The insulation materials, which come in various thicknesses and sizes, are fastened to roof decks with special nails, adhesives, or asphalts.

In some cases, insulation materials are manufactured with roofing material applied to one side. When these are properly taped together, no additional roofing is required on top of them.

Siding Materials

The three major types of siding materials used by roofers are asphalt-covered fiberboard, asbestos-cement, and aluminum. They are generally used to cover or recover the exterior walls of a house for decorative or protective purposes, or for both.

Asphalt-covered fiberboard, one of the three types most often used, comes in a brick or stone pattern. It is cut to size with a knife and nailed in place.

Asbestos-cement siding is similar to the asbestos-cement shingles used on the roof. It comes in various sizes and must be handled carefully because it is brittle and will break or chip.

Aluminum siding in a variety of colors is made with an insulating liner.

Caulking Compounds

Caulking compound is used primarily in the application of siding materials. It is particularly useful in fitting shingles around windows and doors, in working around pipes, in bedding flashing, and to seal cracks.

New caulking compounds are constantly being introduced. However, before an untried product is used, the roofer should understand its use. Basically, caulking compounds fall into these types: (1) self-curing (by the addition of a catalyst they will cure after application); (2) rubber, semi-drying; and (3) rubber, nondrying.

Compounds come in a variety of colors, but black asphalt asbestos fiber plastic is the one most generally used.

Caulking materials are sold in tubes, one- to five-gallon cans, and 55-gallon drums. They are also available in cartridges for use in caulking guns.

Checkup

Asphalt emulsion is supplied both plain and with asbestos fibers. 1. T F

190° melt asphalt is always used on flat decks. 2. T F

Noah's pitch is used for flashing asphalt built-up roofs. 3. T F

Siding comes in three major types--asbestos-cement, aluminum, and __4__-covered. 4. ________

Insulation is used for both heat and __5__ barriers. 5. ________

Topic 5— TOOLS

Assignment : Handy Rules for Hand Tools, prepared by the California State Department of Industrial Relations, Division of Industrial Safety.

Introduction

The tools a craftsman owns and uses in his trade tell a good deal about his attitude toward his trade and the quality of work he produces. If the tools are the correct ones, of good quality, and well cared for, the craftsman is probably one who takes pride in a job well done. If, on the other hand, his tools are of poor quality and poorly cared for, the craftsman is probably one who does a job, but that's about all he contributes to his trade. The apprentice should therefore begin to acquire the tools he will need and, once he has these tools, he should take proper care of them.

Even though practices vary throughout the country concerning the tools a journeyman is required to carry and those the employer must furnish, the workman should be familiar with all the tools he might be called upon to use. In this workbook, the tools most generally furnished by the journeyman are listed and described in this topic. The equipment usually supplied by the employer is discussed in the topic that follows.

Related Information

Basic tools. The roofer should first acquire the basic tools, then add the others as he finds use for them. His goal should be to have a complete kit of well-kept, quality tools.

The basic tools of the roofer include the following:

Tool bag.

Web belt and leather nail pouch that is approximately 8" square.

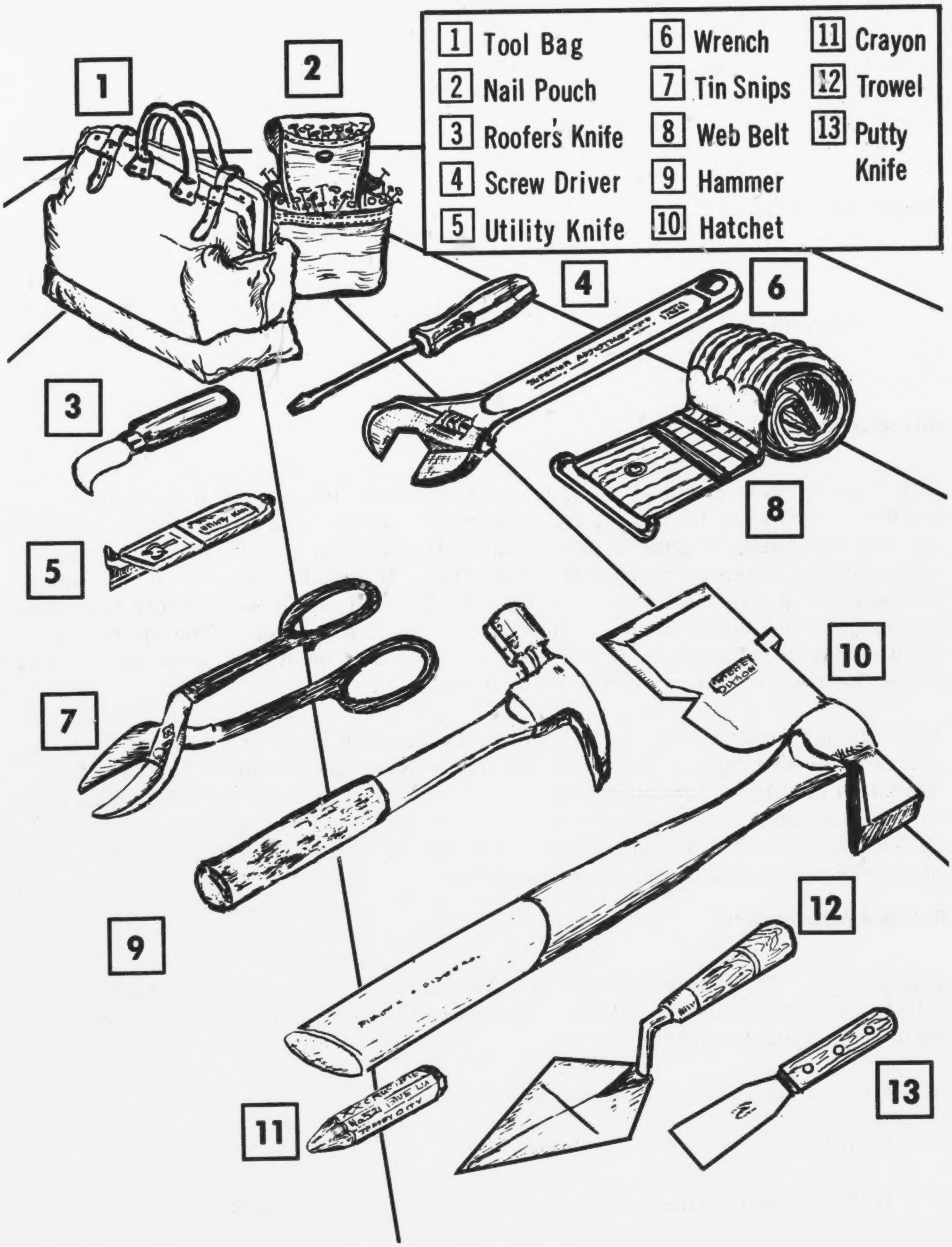


Fig. 9. Roofer's basic tool kit

Hammer. A 16-oz. hammer with straight claw and steel shaft.

Utility knife, also known as a fiberboard knife.

Small 8" crescent wrench.

Medium-size screw driver.

18" tin snips, also called combination snips.

Roofing hatchet. This hatchet differs from a regular wood hatchet in that the blade (which is generally longer and thinner than that of a wood hatchet) is sharpened at one vertical edge as well as at the horizontal edge. This hatchet is used in almost all roofing processes.

> Safety precaution: Be sure the head of the hatchet is secure on the handle. When you drive nails with it, keep your head clear of the blade. Never strike hard metals with the blade end, because it may chip. When the hatchet is not in use, keep the blade shielded.

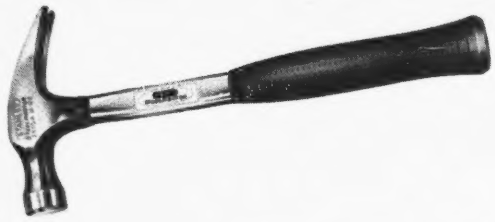
Roofing knife. Also known as a grape pruner's knife, it is similar in appearance to a linoleum knife, but the blade of the grape pruner's knife is thinner, which makes it easier to pull through the material being cut.

Pointing trowel. A must for applying mastics around vents and for pointing up around three-course flashing. The experienced roofer frequently has three sizes of this kind of trowel in his tool kit. The small trowel is used for mastic, medium size for most tile work, and the larger one for laying large quantities of tile. The points of the trowels are generally rounded before the trowels are used. Trowels should be kept clean at all times and never stored until cleaned.

Putty knife.

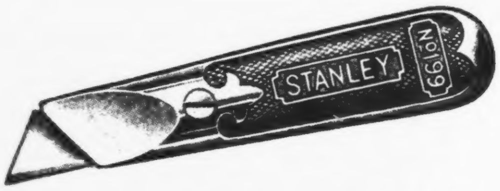
Small can or similar container. This can be used for:

1. Extra shoe laces
2. Faucet handle
3. Assorted screws and bolts
4. Knife blades
5. Shingler's gauges. These are clamped or screwed on the hatchet to gauge the exposure of shingles.
6. Book matches



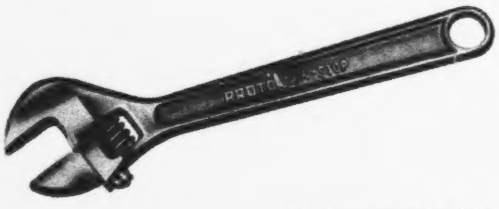
Courtesy Stanley Tool Co.

Fig. 10. Straight claw hammer with steel shank



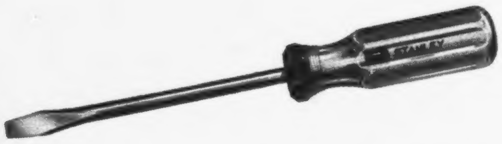
Courtesy Stanley Tool Co.

Fig. 11. Utility knife



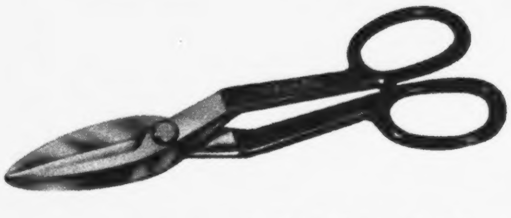
Courtesy Proto Tool Co.

Fig. 12. Crescent wrench



Courtesy Stanley Tool Co.

Fig. 13. Screwdriver



Courtesy Niagara Tool Co.

Fig. 14. Tin snips

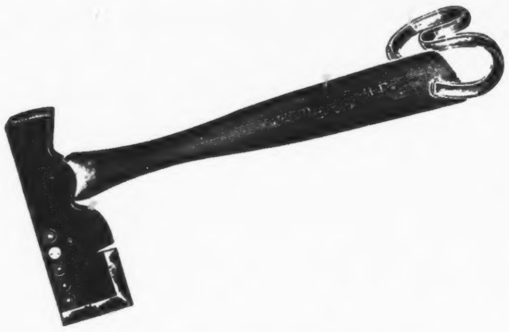


Fig. 15. Roofing hatchet

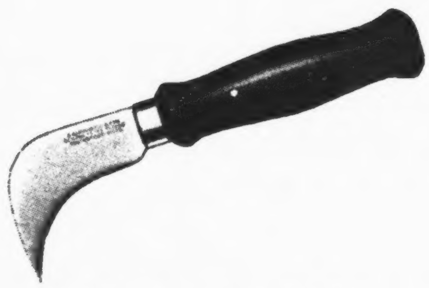
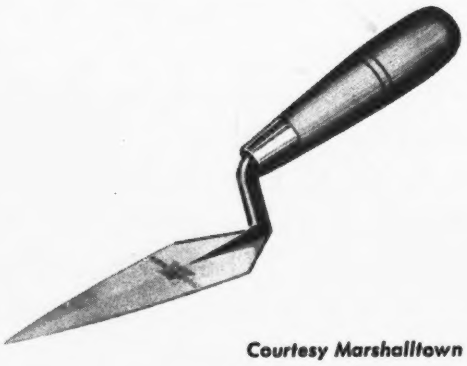
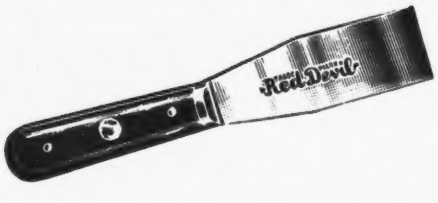


Fig. 16. Roofing knife



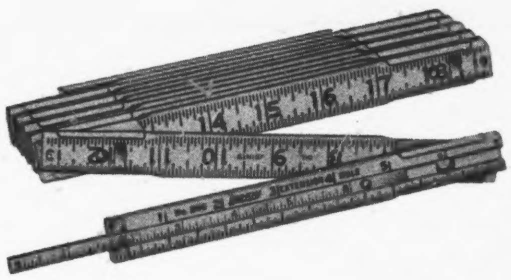
Courtesy Marshalltown

Fig. 17. Pointing trowel



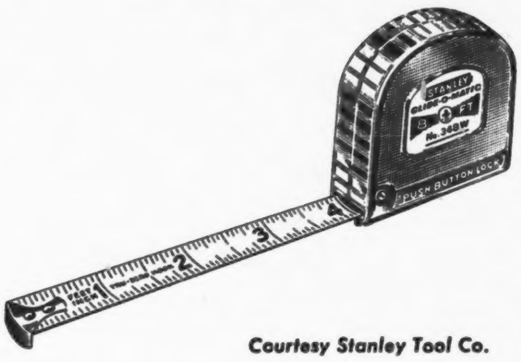
Courtesy Red Devil

Fig. 18. Putty knife



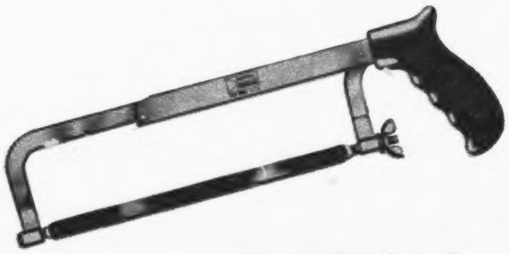
Courtesy Lufkin Rule Co.

Fig. 19. Zig-zag rule



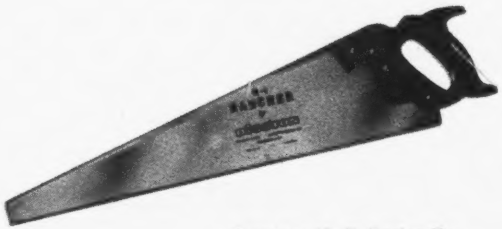
Courtesy Stanley Tool Co.

Fig. 20. Push-pull rule



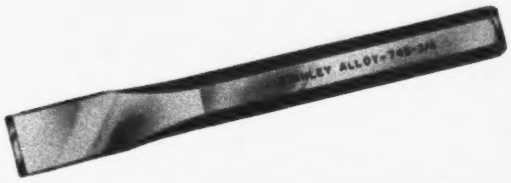
Courtesy H. K. Porter Co.

Fig. 21. Hacksaw



Courtesy H. K. Porter Co.

Fig. 22. Handsaw



Courtesy Stanley Tool Co.

Fig. 23. Cold chisel

Proper clothing. Well chosen, proper clothing is the mark of the professional. The roofer needs high-top shoes, several work shirts and pants, a hard hat and leather gloves. (See safety rules, Topic A-2.)

General tools. The following tools, commonly used in the building trades, are particularly important to the roofer:

Measuring tapes. Cloth tapes are generally preferred by roofers because they cannot be kinked, weigh less than metal tapes, and will follow the contours of a roof.

Rules. The roofer uses both zig-zag and push-pull types.

Hacksaw.

Handsaw. A 26" blade is commonly used.

Cold chisel.

Side-cutting or diagonal-cutting pliers. Used mostly for cutting tile ties and tie wires.

Levels. Metal levels in various lengths are commonly used. A line level is also used.

Chalk-line reel. Used to snap straight lines on decks, felts, and walls. A powdered chalk, available in several colors, is contained in the reel canister.

Framing square or steel square.

Wing dividers. Used in making layouts for roof tile.

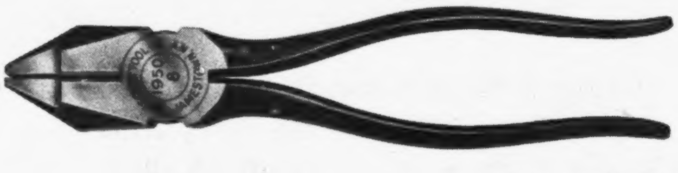
Hand drill.

Other roofing tools. The following are the more specialized tools used by the roofer on his job:

Tile pincers. Also called nippers, these are used for cutting or nipping off chips of roofing tile.

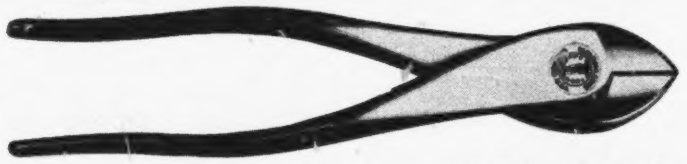
Shingle and slate ripper. Used for pulling nails and for removing shingles of slate.

Tile pick. A pick designed for cutting tile which may also be used to make new holes for nails and drains. It may have a round, square, or



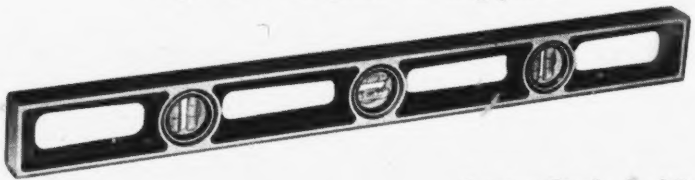
Courtesy Crescent Tool Co.

Fig. 24. Side-cutting pliers



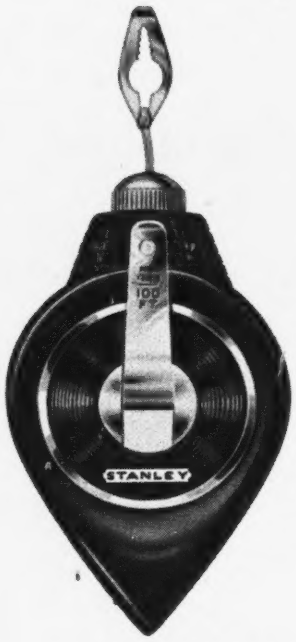
Courtesy M. Klein & Son

Fig. 25. Diagonal-cutting pliers



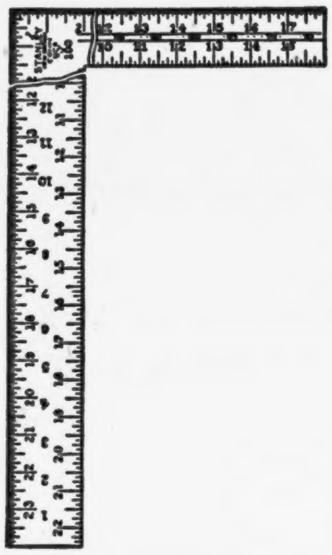
Courtesy Stanley Tool Co.

Fig. 26. Metal level



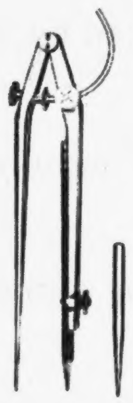
Courtesy Stanley Tool Co.

Fig. 27. Chalk line reel



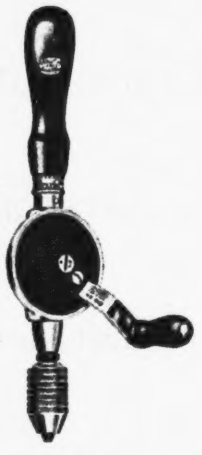
Courtesy Stanley Tool Co.

Fig. 28. Framing square



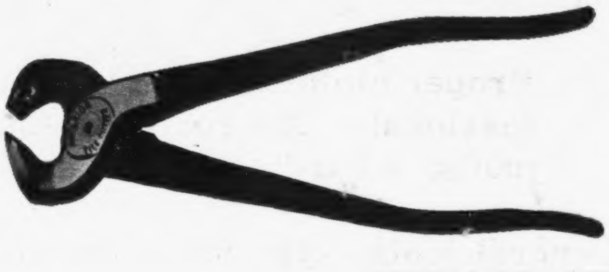
Courtesy L. S. Starrett Co.

Fig. 29. Wing dividers



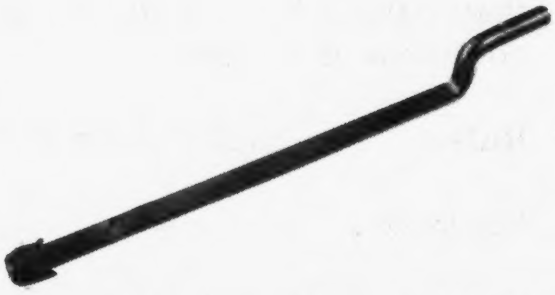
Courtesy Stanley Tool Co.

Fig. 30. Hand drill



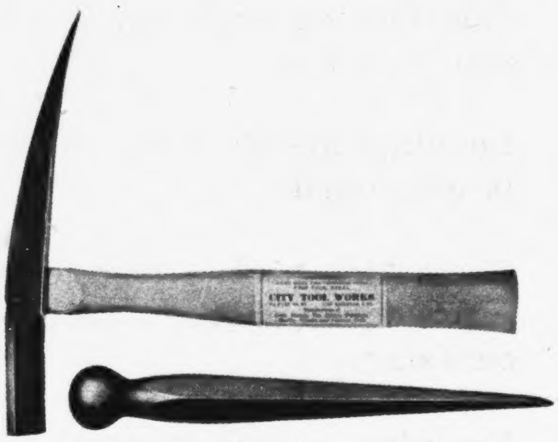
Courtesy Superior Tool Co.

Fig. 31. Tile pincers



Courtesy Blackwell Burner Co.

Fig. 32. Shingle and slate ripper

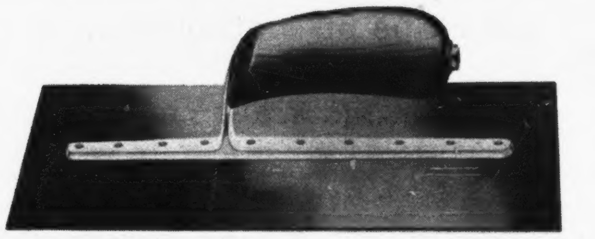


Courtesy City Tool Works

Fig. 33. Tile pick and tile stake

Courtesy L. S. Starrett Co.

Fig. 34. Slater's scribe



Courtesy Marshalltown

Fig. 35. Flat trowel

hexagonal head, the latter preferred. The head may be used to drive nails for tile or slate. The best tile picks are custom made.

Safety precautions: When using the pick to drive nails, keep your head well clear of the pick to avoid injury from the sharp point. Keep the pick wrapped in cloth to protect the point when in storage.

Tile stake. A custom-made tool used to support tile while it is being shaped or cut with a tile pick. The tile stake should be sheathed when not in use.

Slater's scribe. This is used to punch holes in slate and also to mark the slate for cutting it to fit.

Helmet. On some construction jobs workers are required to wear protective helmets, generally called "hard hats." They are made of fiber or aluminum.

Flat trowel. A flat or plastering trowel used in the application of plastic cement in large areas. Sometimes one end and one edge are serrated.

Wire brush. Where flashing is to be applied to a brick surface, a wire brush is used to remove the white powder that forms on the brick.

Checkup

A tile pick may also be used to drive nails. 1. T F

The shingler's gauge is used to protect the hatchet blade. 2. T F

Roofing contractors furnish all tools for the roofer. 3. T F

A shingler and slate ripper is used to help hold shingles or slate for nailing. 4. T F

The tool generally used for cutting off chips of roofing tile is the pointing trowel. 5. T F

A putty knife should be on the apprentice's list of basic tools. 6. T F

The roofing hatchet differs from a wood hatchet in size only. 7. T F

The most generally useful handsaw for roofers is one with a 26" blade. 8. T F

Topic 6— EQUIPMENT

Assignment

1. Construction Safety Orders, Division of Industrial Safety, California State Department of Industrial Relations, Sec. 1654, 1675-79, and Appendix 3, Operation 58.
2. Manufacturers' catalogs of roofing equipment.

Introduction

New tools and equipment for use in applying roofs and new roofing materials are being introduced at a rapid pace. In most instances the use of these machines will result in reduced labor costs, and, used in conjunction with the new roofing materials, will result in an improved product.

The journeyman roofer must therefore stay informed regarding new materials, techniques, and equipment, and above all else know how to use them correctly. He can learn a great deal about items new to his trade by studying trade journals, manufacturers' catalogs, and specification manuals.

Related Information

Portable Electric Hand Tools

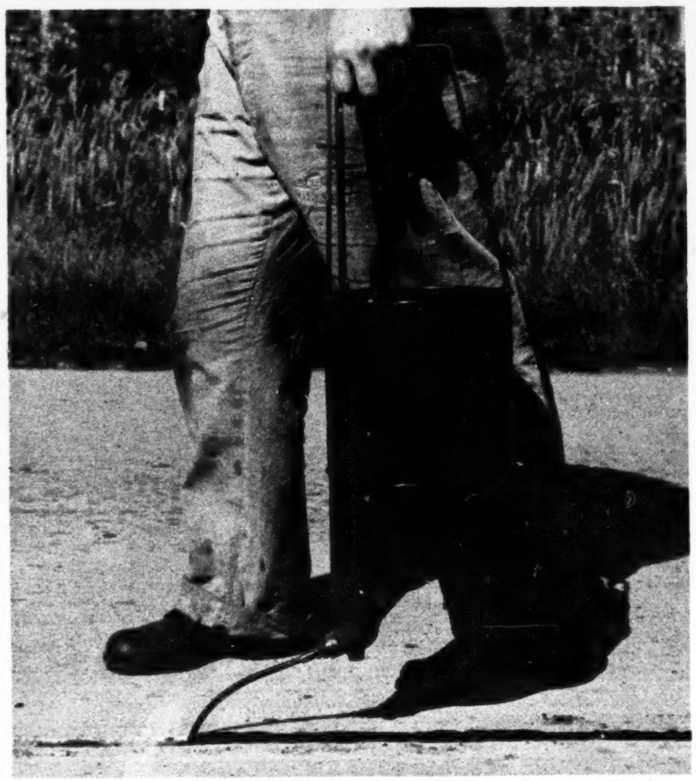
Portable electric saw. The portable electric saw is described in the Introduction to Apprenticeship. The roofer generally uses a carborundum blade, since he uses it for such things as cutting reglets that have been left out of walls.

Equipment for Handling Hotstuff

Buckets. Many different kinds of buckets are used in the roofing industry, but those listed here are the most common types. A general safety precaution for the use of any bucket is to be sure that it is empty of water before using it, because water in the bucket may cause hot asphalt to boil over.

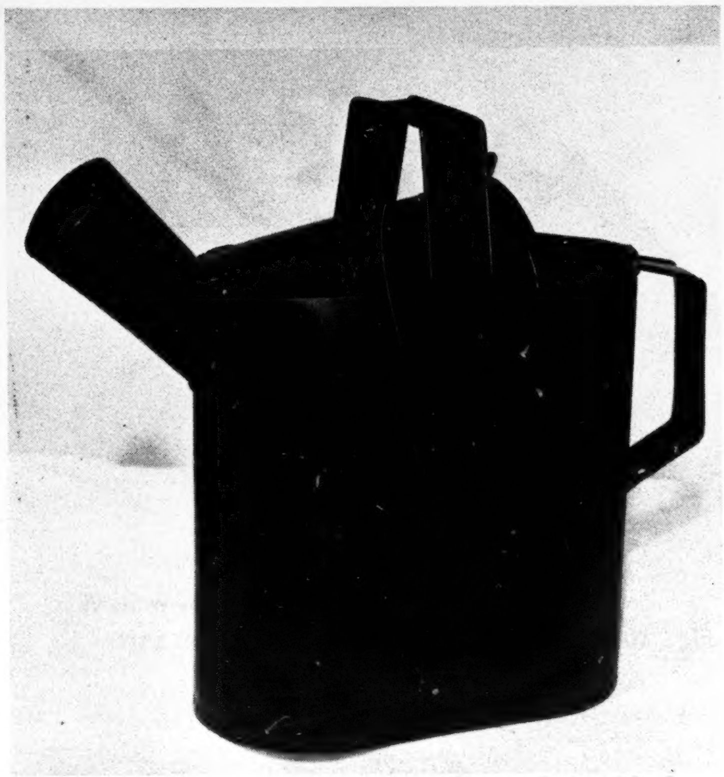
A special bucket called a "crack filler" is used by the roofer to fill expansion joints, cracks or joints in cement with hot asphalt.

A sprinkler pot is used for sprinkle-pouring of bitumen on the surface of built-up roofs before graveling or similar jobs.



Courtesy Tarrant Mfg. Co.

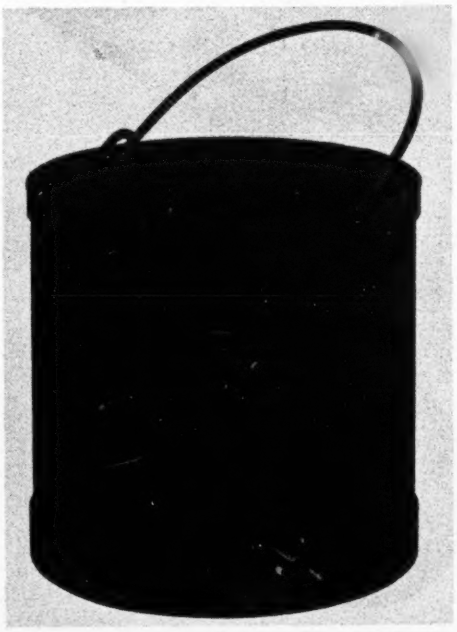
Fig. 36. Crack filler in use



Courtesy Tarrant Mfg. Co.

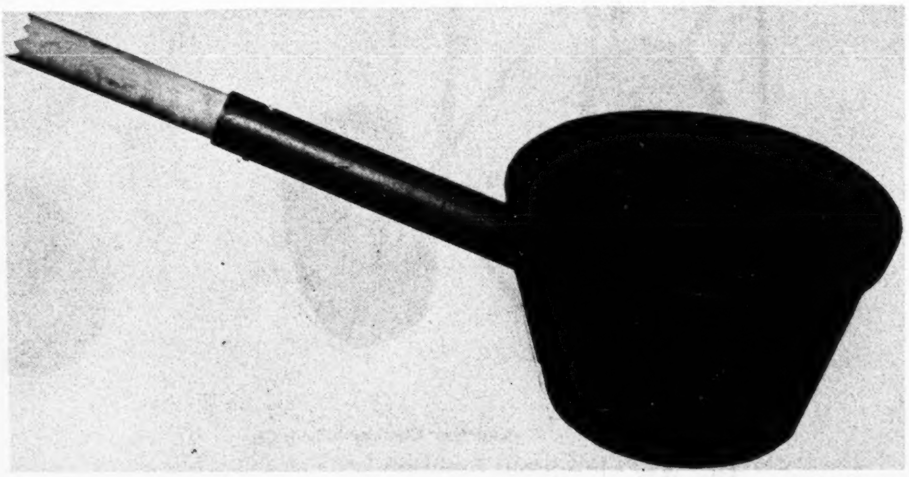
Fig. 37. Sprinkler pot

The roofers' bucket is made of 24-gauge steel. Its round iron carrying handle rests off the top to engage a hoisting hook. In some cases, this bucket is insulated to help hold the heat.



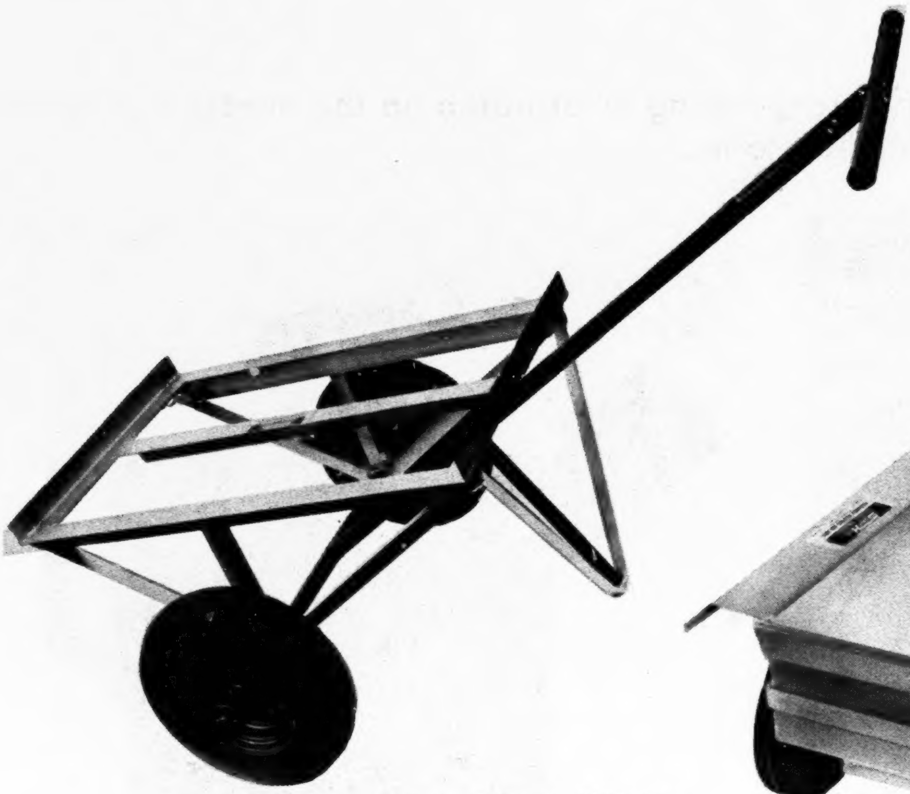
Courtesy Tarrant Mfg. Co.

Fig. 38. Roofer's bucket



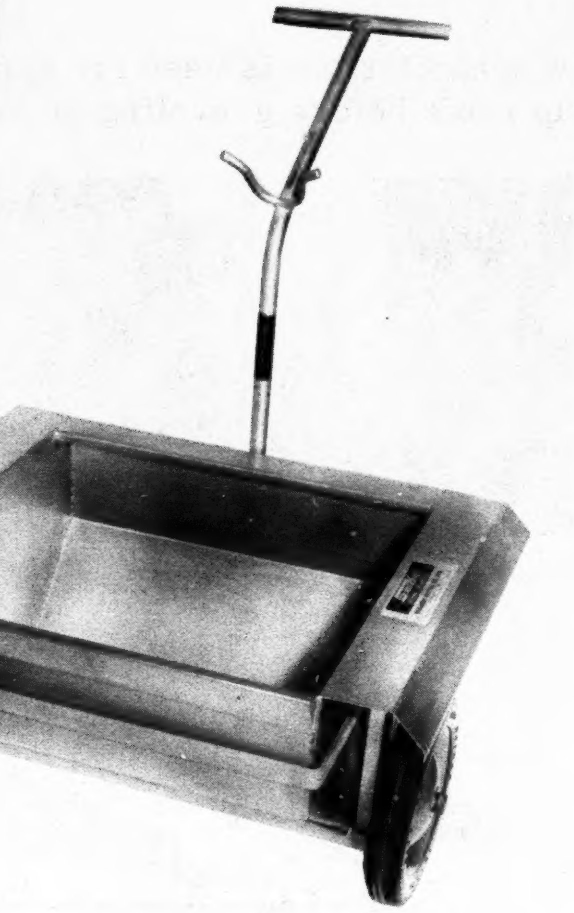
Courtesy Tarrant Mfg. Co.

Fig. 39. Dipper



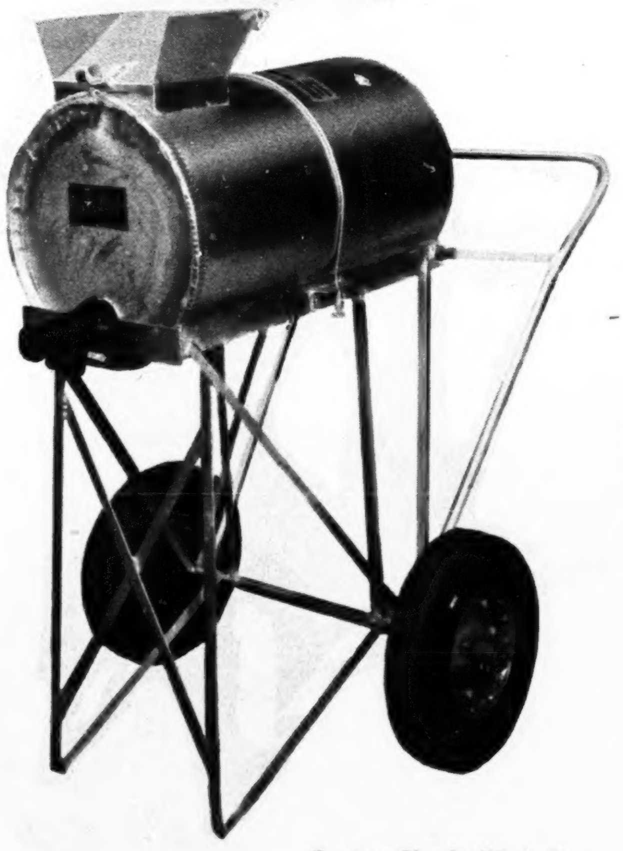
Courtesy Cleasby-Wittig Co.

Fig. 40. Dumping type insulation and felt cart



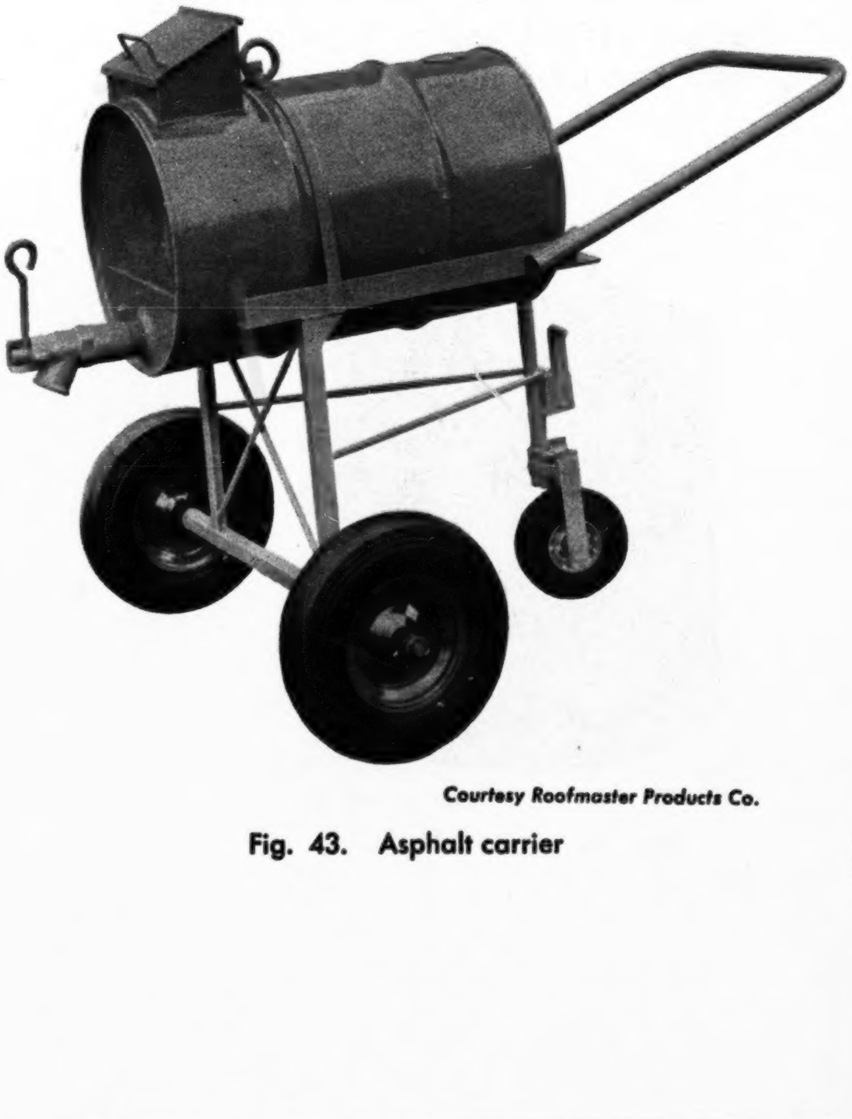
Courtesy Cleasby-Wittig Co.

Fig. 41. Mop cart with removable tray



Courtesy Cleasby-Wittig Co.

Fig. 42. Insulated highboy



Courtesy Roofmaster Products Co.

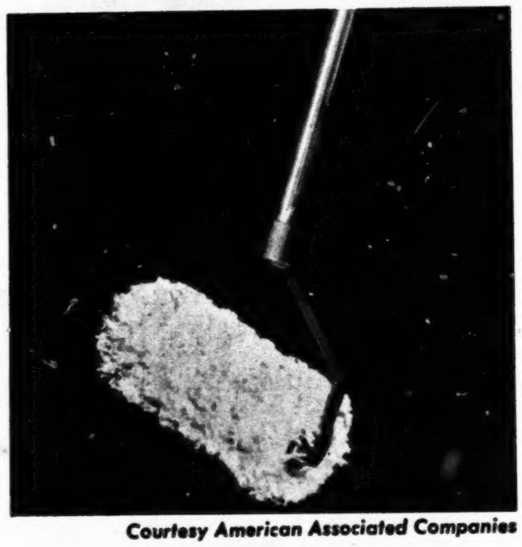
Fig. 43. Asphalt carrier

A lightweight dipper or ladle is used for hot tar or asphalt. It has a long, hardwood handle.

Carts. Carts are used for various hauling jobs, such as transporting rolls of felt and insulation and pails of hotstuff. Mop carts, some designed with removable trays to carry hotstuff, are in wide use on larger roof jobs today.

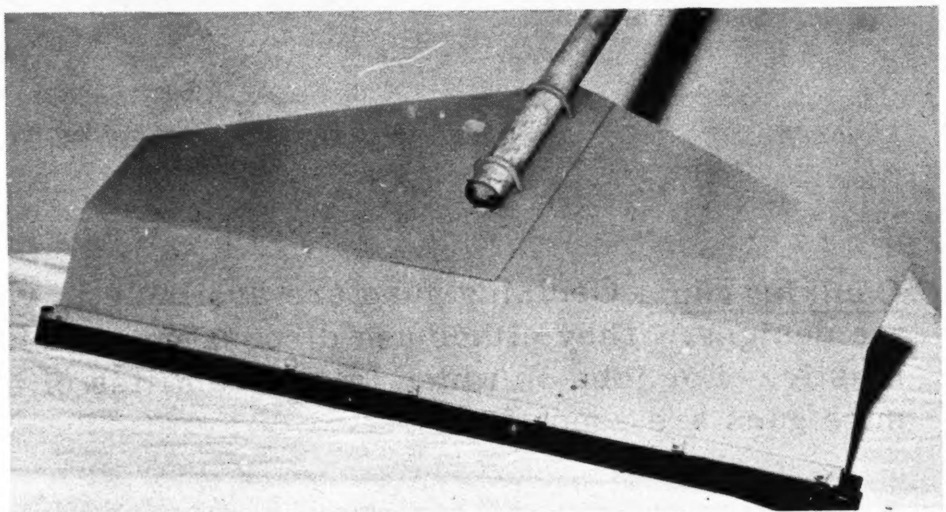
Highboys. The highboy is a drum mounted on a frame equipped with wheels, so it can be moved around the roof easily to deliver hotstuff where needed. It is used on large jobs where the hotstuff is pumped to the roof and into the drum.

Mops. Mops are made with various size heads of fiber glass or cotton. Cotton mops hold larger quantities of asphalt than glass mops of the same size, but glass mops are more durable and easier to drain. Both aluminum and wood are used for the handles.



Courtesy American Associated Companies

Fig. 44. Roller mop



Courtesy Tarrant Mfg. Co.

Fig. 45. Bituminous squeegee

Roller mops. The roller mop is used for applying hot asphalt in the waterproofing of walls and the like. A similar roller with short strands is used for applying roof coatings.

> Safety precaution: Be sure mops are cleaned, fanned out, and placed where they will not become fire hazards through spontaneous combustion. Never leave a mop on a roof overnight.

Another piece of equipment in common use is the bituminous squeegee. It is generally used for spreading emulsions and waterproofing compounds and for coating the blocks in industrial plants.

Shingling Equipment

Brackets. The shingler's bracket fits a 2" × 4" on edge to make a safe toe hold on roofs of less than 1/4 pitch (see Fig. 46).

Roofing brackets are required for all roofs of 1/4 pitch or steeper. For spans of less than 10', lumber not less than 2" × 6" must be used. The roofing bracket for this size plank, shown in Fig. 47, has three notches for fastening and can be used on all slopes including 1/2 pitch. For spans of 10' or more, the lumber used must be 2" × 8". The roofing bracket for this size plank, shown in Fig. 48, has a simple locking device to prevent accidental closing of the bracket. (See Construction Safety Orders, Section 1717.)

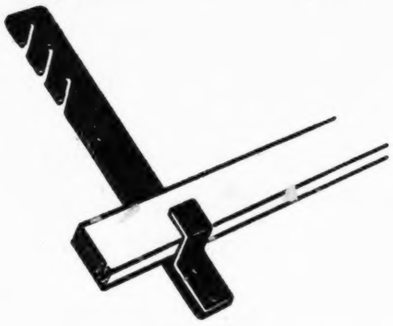


Fig. 46. Shinglers bracket

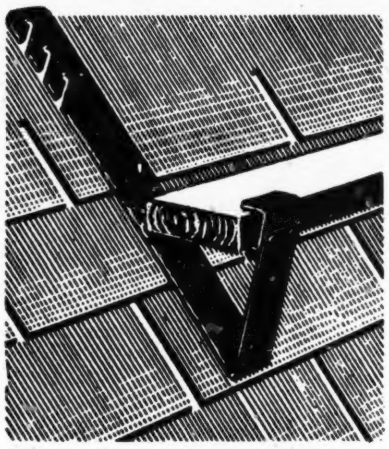


Fig. 47. Roof bracket for 2" × 6"

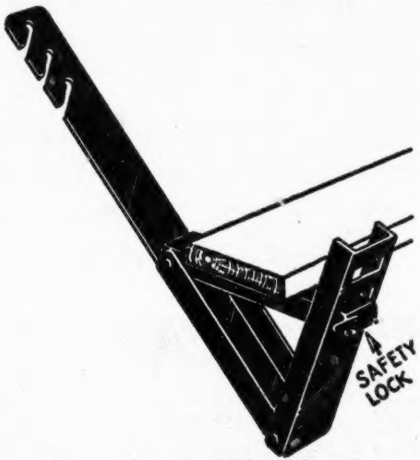


Fig. 48. Roof bracket for 2" × 8"

Courtesy Reimann and Georger

Caulking guns. Caulking guns are available in various sizes and with many nozzle designs. They either use disposable cartridges or can be filled with bulk mastic. For jobs on which large quantities of mastic are required, air pressure guns are used.

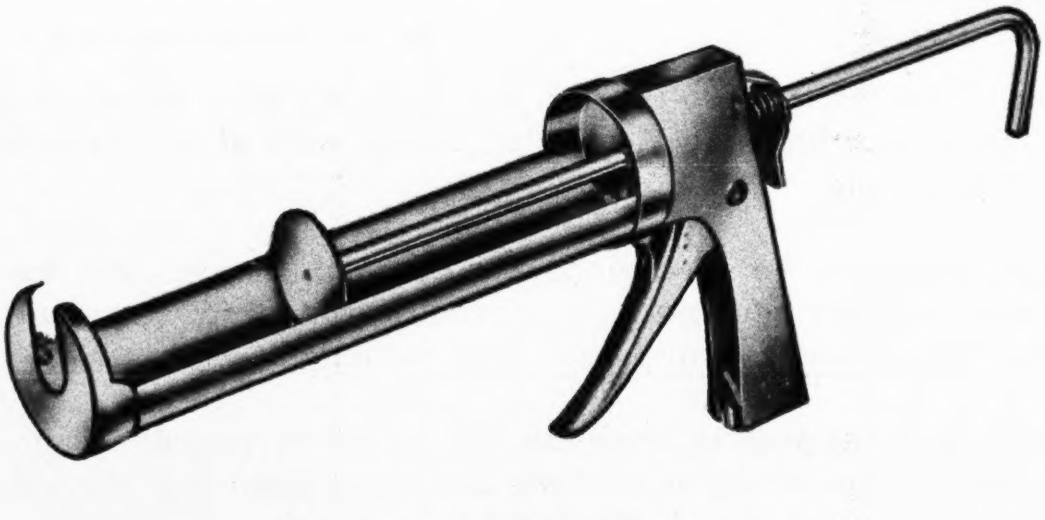


Fig. 49. Cartridge type caulking gun

Precaution: Always keep the caulking gun clean while in use as well as in storage. In particular (on bulk-type guns), the leather plunger must be kept oiled.

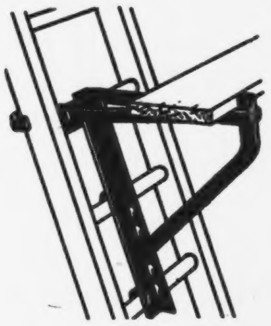
Asbestos-cement siding and shingle cutter. This tool is used by roofers for cutting both asbestos-cement siding and shingles to fit specific areas.

> Safety precaution: Before using the cutter, be sure it has an adequate bearing surface and is securely anchored on the roof or scaffold.

Ladders. Only those ladders supplied by your company should be used--and checked for safety before use. General safety rules for the use of ladders are given in Ladder Safety (Bulletin 121, Division of Industrial Safety) and in Construction Safety Orders.

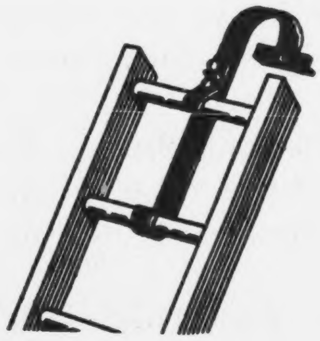
An adjustable ladder jack, which rests on three ladder rungs and hooks on the side rail (Fig. 50), can be adjusted to use over or under a ladder. (See Construction Safety Orders, Sections 1654 and 1675.)

The ladder hook (Fig. 51) is equipped with a swivel plate that allows a ladder to be hooked over a ridge. The plate prevents the hooks from digging into asphalt roofing.



Courtesy Reimann and Georger

Fig. 50. Adjustable ladder jack

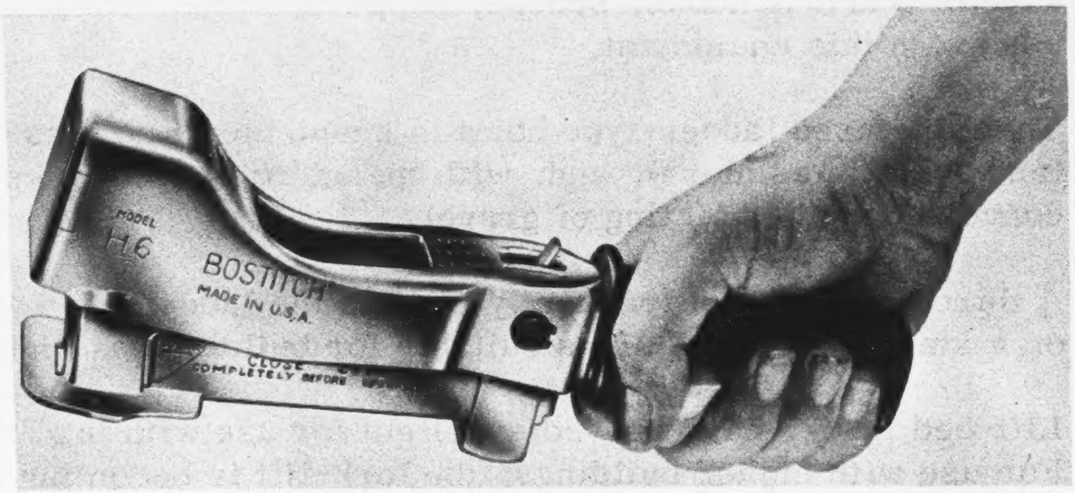


Courtesy Reimann and Georger

Fig. 51. Ladder hook

Stapling equipment. Staples are sometimes used for applying roofing material, particularly composition shingles. They can also be driven through tin disks for application of roofing felts. In any case, they are used only when the material is applied directly to the deck, on either an old or new roof.

Fig. 52. Stapling hammer



Courtesy Bostitch

Staples are applied with a stapling hammer. The hammer should be soaked in kerosene after each day's use to remove all asphalt, then dried and lubricated before it is used again.

Kettles and Pumps

Various types of kettles and pumps are used in roofing. These are discussed at length in Unit E, along with their operation and maintenance.

Hoists and Conveyors

The selecting of the hoists and conveyors for getting equipment and materials to the roof will depend upon the type of job being performed. In the case of new high-rise buildings, the roofing contractor generally makes arrangements with the general contractor to use his hoisting equipment. When this is not possible, he may use his own equipment or hire the services of a hoisting company. When reroofing a high-rise structure, the roofing contractor may use the freight elevator or, if none is available, a passenger elevator. Should this be necessary, the roofing crew must be sure that all care is taken to avoid damaging the elevator.

For lower buildings, the roofing contractor usually uses one or several of the different pieces of equipment described below. His choice is governed by the requirements of the job.

Hoists. As a rule, hoists are capable of lifting things higher than are conveyors, because conveyors must generally be set at a greater angle.

Types of hoists used for roofing are the A-frame and winch, ladder-type, ladder hand wheel, and such lifting equipment as lift-bed trucks and fork lifts.

An A-frame roof beam is used for handline hoisting. A variation of this is the swing type, which is used for handline roof hoisting as well as with the power winch. Various hooks, scoops, hoppers, forks, buckets, and tongs may be used with this equipment.

The motorized ladder-type hoist is adaptable to heights of 10 feet to 30 feet (and sometimes more), and, with the addition of a bucket and hopper, may be converted to the hoisting of gravel.

A third type of hoist frequently used is the ladder hand wheel, which is mounted on a standard ladder. It is suitable for buildings as high as two stories.

Lift-bed trucks have proved excellent for use with low, one-story structures. For use with higher buildings, the fork-lift is becoming popular.

The Lad-E-Vator

The Lad-E-Vator is a skip type hoist that handles all types of roofing material except hot asphalt. It will handle loads up to 1,200 pounds at each lift.

Shown here being used on the Sacramento Court House, this hoist is lifting materials to 103'. It can be used on heights of 20' or more. It is made of extruded aluminum and is telescopic, so it is not heavy and set-up time is at a minimum.

As it is attached to a swivel carrier and one man can set it up to heights of 40', this hoist is extremely portable. Heights above that require extension and bracing as shown in the picture.

A line of thin wall tubing, extending from the kettle to the roof, which provides the hot asphalt, is used in conjunction with this equipment. Required materials for roof construction can be handled efficiently with this arrangement.

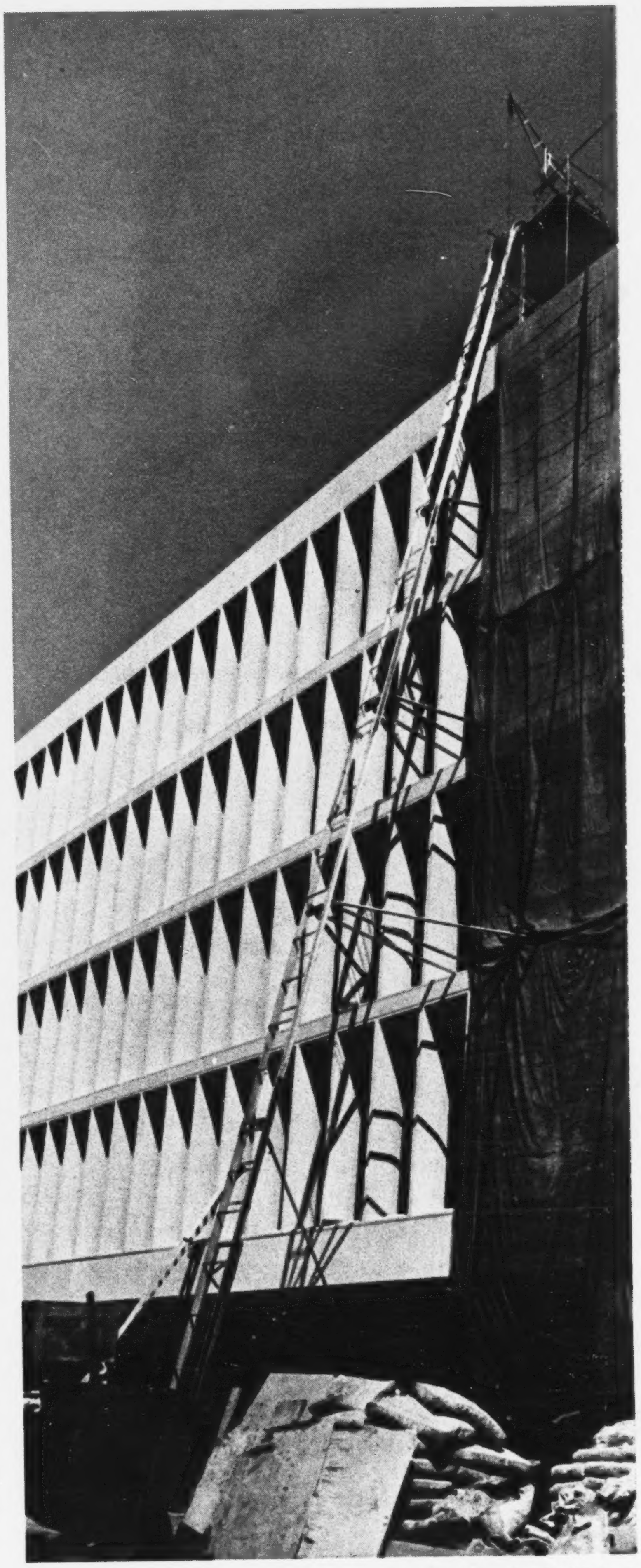
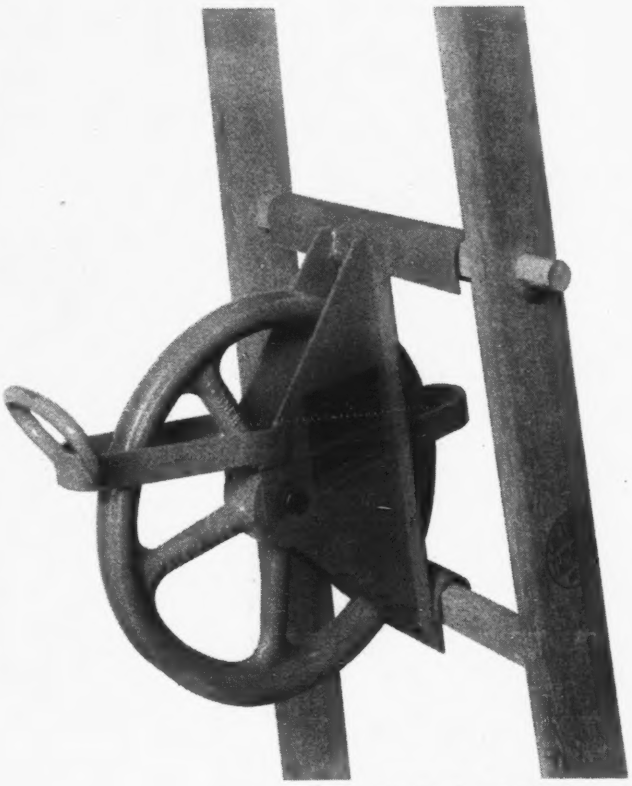


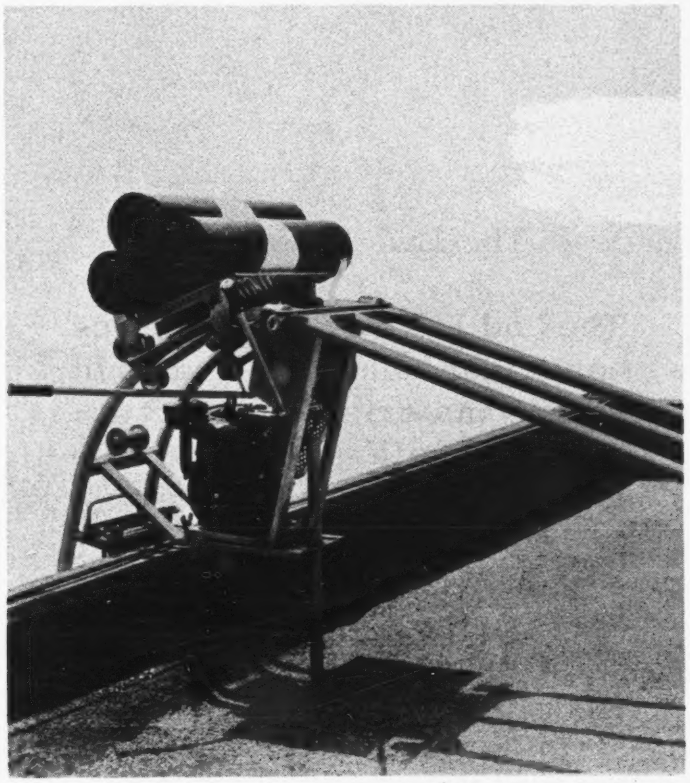
Fig. 53. Lad-E-Vator in operation

Courtesy Cleasby-Wittig Co.



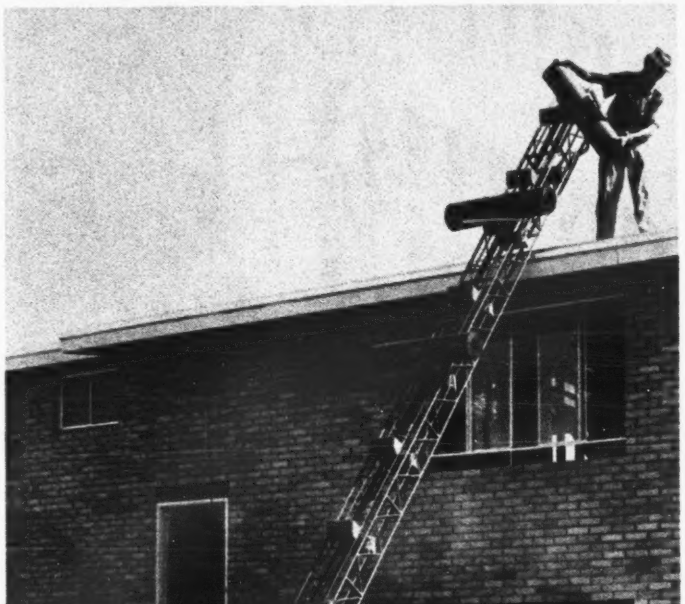
Courtesy Roofmaster Products Co.

Fig. 54. Ladder wheel for hoisting



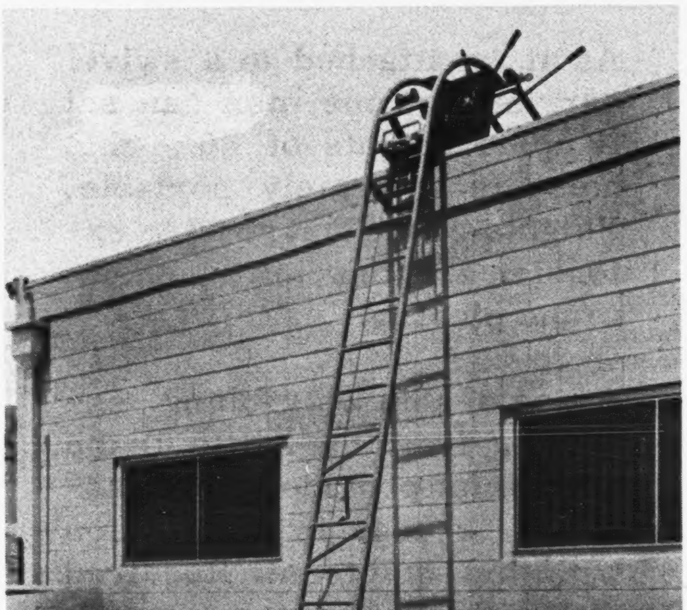
Courtesy Roofmaster Products Co.

Fig. 55. Top power section of hoist



Courtesy Clear-Field Mfg. Co.

Fig. 56. Continuous chain conveyor



Courtesy Roofmaster Products Co.

Fig. 57. Power hoist in operation

Conveyors. The two main types of conveyors used by roofers are the continuous belt and continuous chain. Most of these conveyors are easily portable, and they are generally equipped with buckets or hoppers for lifting specific materials.

Felt Layers and Gravel Spreaders

Felt layers and gravel spreaders have been perfected to permit almost perfect application. Machines are now available that apply flood coat and gravel in one operation. Although this procedure is successful on large jobs, hand operations are still required on most small jobs. Even on large jobs, application around skylights, flashings, and parapet walls still requires hand operation.

Felt layers. The two principal types of felt layers used are the dry layer, which requires a man to mop in front of it, and a combination layer, which flows asphalt onto the deck as it lays the felt.

The combination felt layer has many variations. With some, the asphalt is applied by means of gates or valves. With others, such as the rotary felt layer (a stationary unit), the asphalt is applied directly to the felt by means of a drum.

Some layers are only suitable for working on level or nearly level roofs. Others can be adapted to sloped roofs by means of adjustable legs. However, the greater the slope, the less practical the use of an automatic felt layer.

> Safety precaution: Because a roofer walks backward while operating a felt layer, he must exercise extreme care to avoid backing into skylights or off the roof. This type of accident seems to happen daily, in spite of precautions. The Construction Safety Orders of California require that a felt layer should never be operated without approved barricades at roof openings and perimeters. (See Construction Safety Orders, Title 8, Appendix 3, Roofing Operation No. 58.)

Gravel spreaders. Some gravel spreaders are hand-operated--that is, they are pulled or pushed by one or two men--and others are mechanically operated. With all of them, the gravel flow can be adjusted for the individual job.

Safety Equipment

Respirators. Respirators are used for protection against concentrations of fumes and vapor common in spray painting and cleaning operations.

> Safety precaution: Keep respirators in sanitary condition; use proper respirator for function performed.

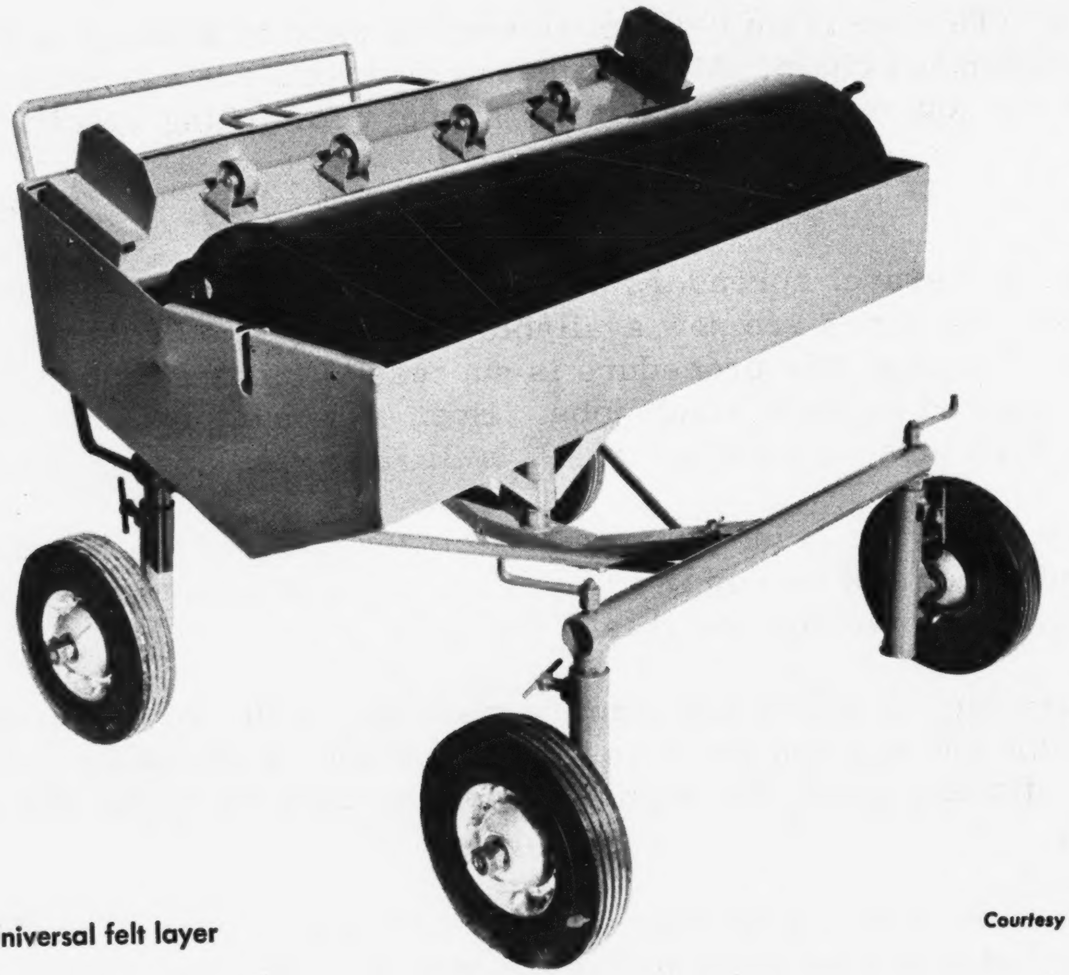


Fig. 58. Universal felt layer

Courtesy Cleasby-Wittig Co.

Roller Type Felt Layer

The roller type of felt layer consists of a roller or drum set in a trough which is mounted on four wheels, each with height adjustment. The trough swivels a full 360°.

The felt is laid on casters and is in contact with the drum. The felt is then pulled over the drum and layed on the ply line in about 18' lengths. After 18' has been pulled out, the machine may be backed up to lay the rest of the roll, or the felt may be cut and the machine moved over 1 ply and another 18' sheet pulled out.

This machine can be used on steep roofs, such as barrel or mansard.

As the felt is pulled from the machine, it is pulled over the rollers; this transfers the asphalt from the roller to the felt, thus eliminating hand mopping.

It is important to keep the temperature of the asphalt in the felt layer to about 400° to insure sufficient asphalt application. The higher the temperature, the less asphalt will be applied to the felt.

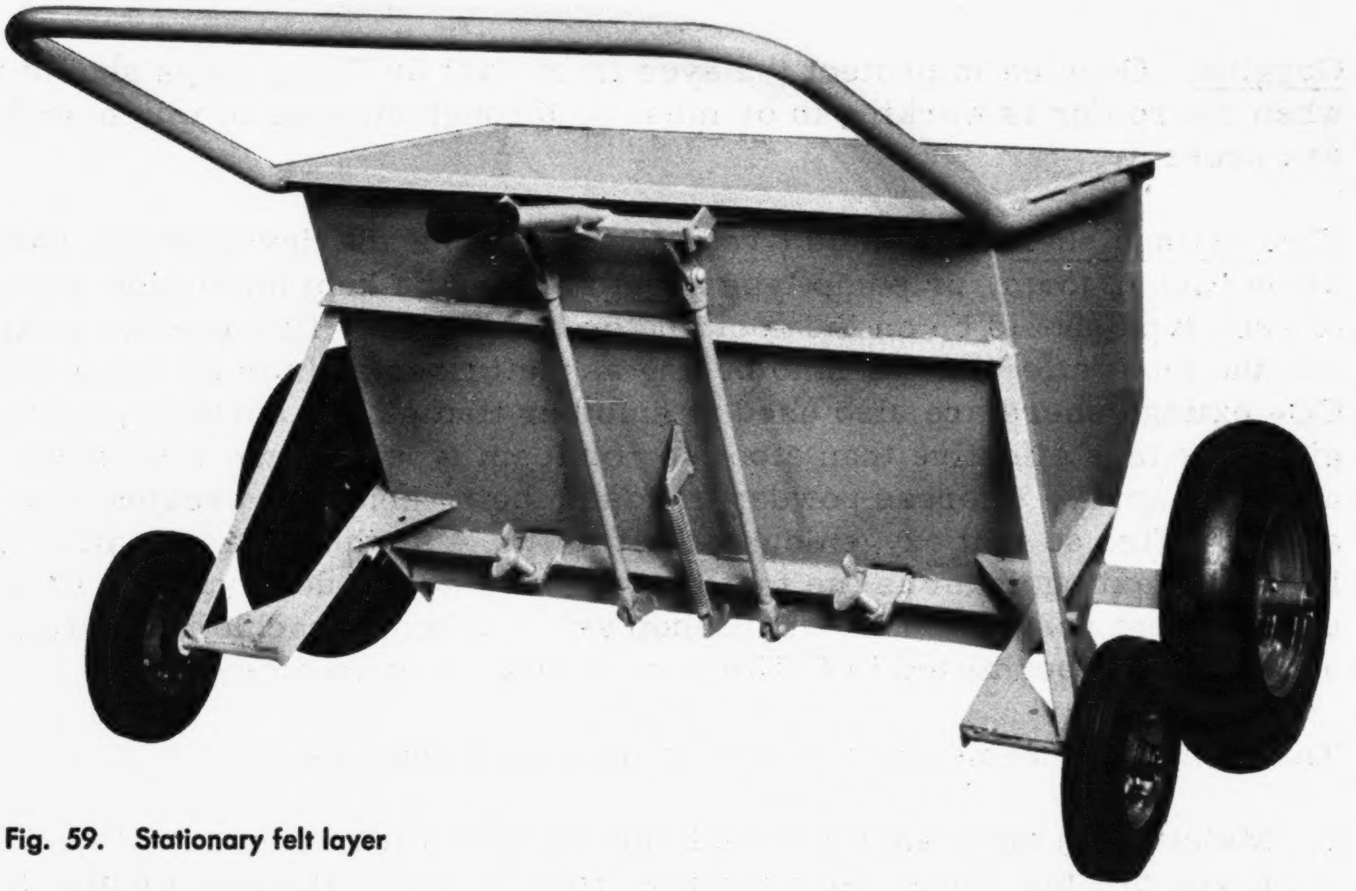


Fig. 59. Stationary felt layer

Courtesy Roofmaster Products Co.

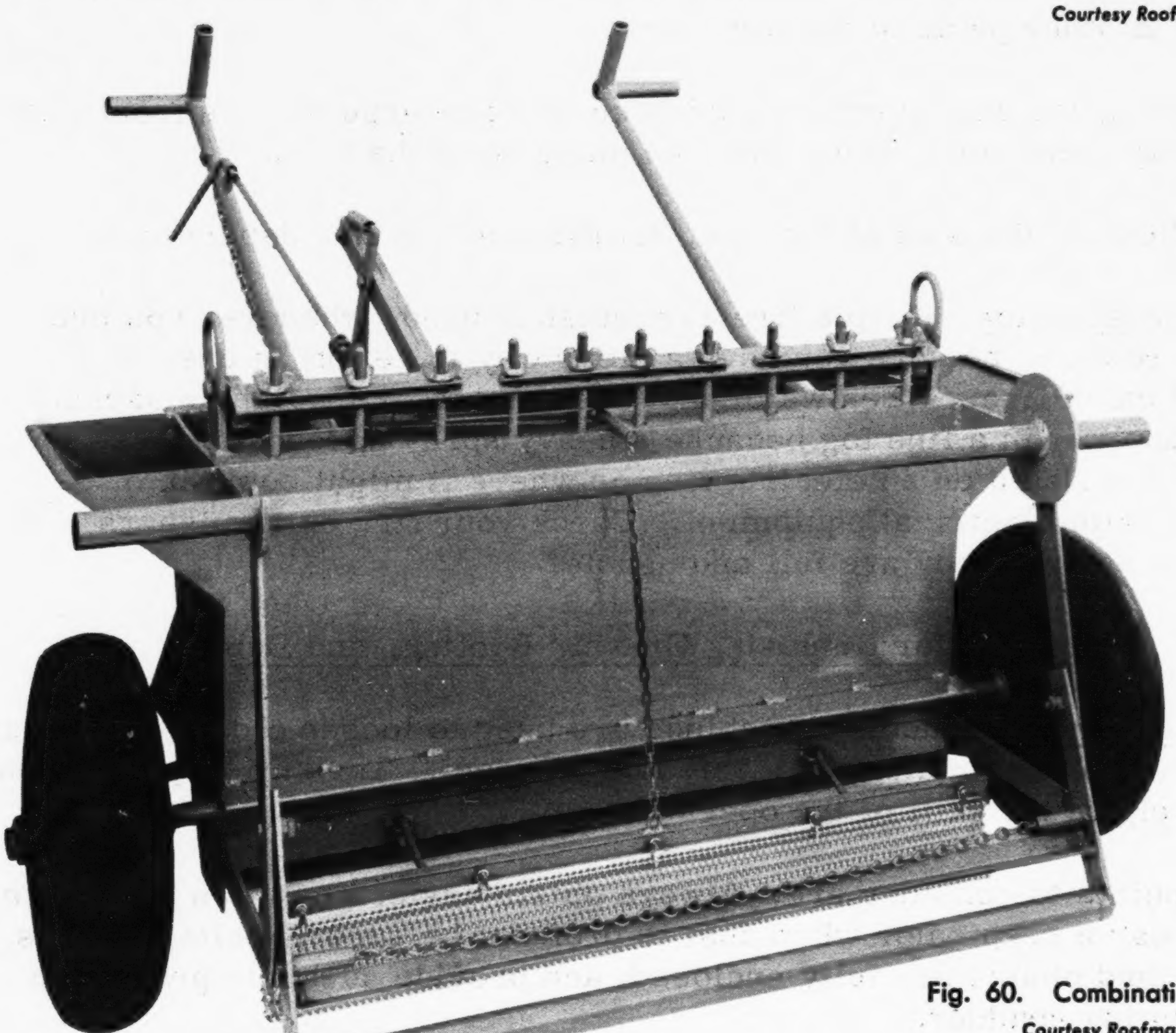


Fig. 60. Combination felt layer

Courtesy Roofmaster Products Co.

Goggles. Goggles to protect the eyes from dust or flying chips should be worn when the roofer is working in or must go through an area in which such things are present.

Fire extinguisher. Portable fire extinguishers of the dry-powder, carbon dioxide (CO_2), foam, or pump type should always be kept on the job; one or more of each type should be on the roof and on the ground. Dry-powder extinguishers are the most effective for smothering asphalt fires and for all small blazes. CO_2 extinguishers are also used to smother flames. A spray-type fire extingisher is less effective than a powder or foam type because wind tends to blow away the spray, whereas powder or foam, being heavier, creates a shield around a fire so that oxygen cannot get to it. A further consideration in choosing a fire extinguisher is the fact that neither the powder-type nor CO_2 leaves a permanent residue on the surroundings. Carbon tetrachloride extinguishers are no longer permitted in California because of toxic effects.

Three things to remember when fighting a fire are these:

1. Maintain an adequate distance from the fire when using an extinguisher. If you are too close, the pressure from the fire extinguisher may blow the flames to other parts of the structure.

2. When using the extinguisher, hold it so its discharge sweeps from side to side away from you. Thus, you can move up to the fire.

3. Regardless of the size of the fire, always call the fire department.

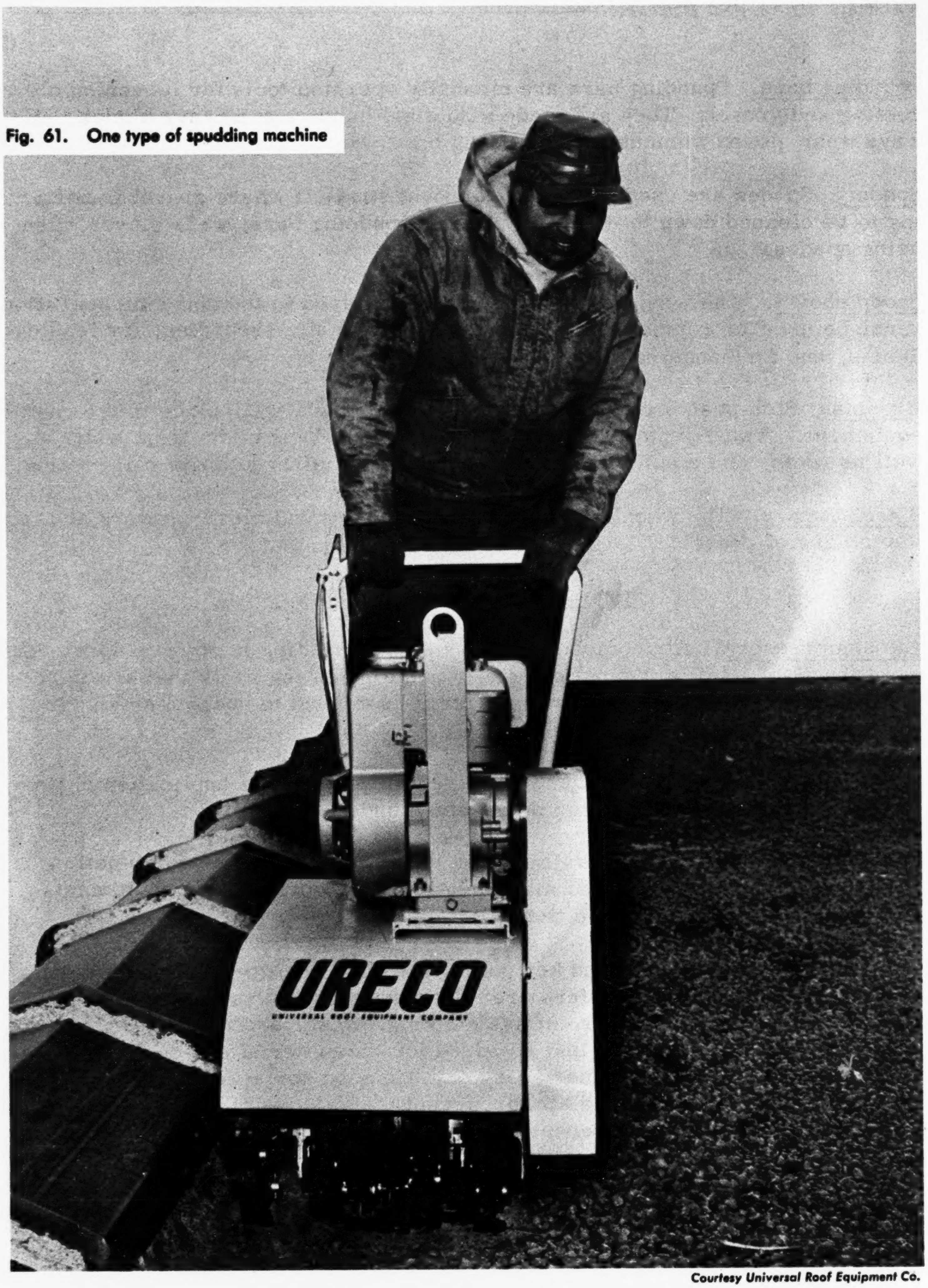
> Safety precaution: Keep a fire extinguisher handy whenever you are on the roof and be sure you have a clear way to get off in case it should catch fire. When water must be used to extinguish an asphalt fire, apply it in a fine fog because a heavy spray spreads flames. Never use liquid on an electric fire or where it might come into contact with electrical equipment. Check your fire extinguishers daily to be sure they are full and usable.

Equipment for Removing Gravel, Roofing, and Debris

Spudding machines. Spudding machines are used to loosen old roofing or gravel. Their operation is comparatively safe and efficient. The key to quality results rests entirely in the skill of the operator.

The main points to consider are: Always obtain assistance when lifting the spudder; wear a respirator when dust is profuse; be sure V-belts, pulleys, sprockets, and chains are fully enclosed; and provide adequate protection against rotating spudders.

Fig. 61. One type of spudding machine



Courtesy Universal Roof Equipment Co.

Spudding bars. Spudding bars are manually operated tools for loosening old roofing and gravel. They are made with steel handles and heavy blades. Always wear gloves when using a spudding bar.

Spades. Spades are used primarily for light spud-off where gravel is not going to be cleaned down to the felt. As with spudding bars, wear gloves when using spades.

Scoop shovel. The scoop shovel is another tool used in the spudding operation. It can be used for removing old roofing and gravel after spudding, for loading debris, and for hand graveling.

Brooms. Both push brooms and upright brooms have their place in the roofers' equipment. A stiff-bristled broom is used to clean heavy dirt from walls as well as roofs, and a soft-bristled broom is used mainly to apply roll roofing.

Wheel barrow. The wheel barrow is useful for general clean-up work and for the moving of gravel.

Spray Equipment and Brushes

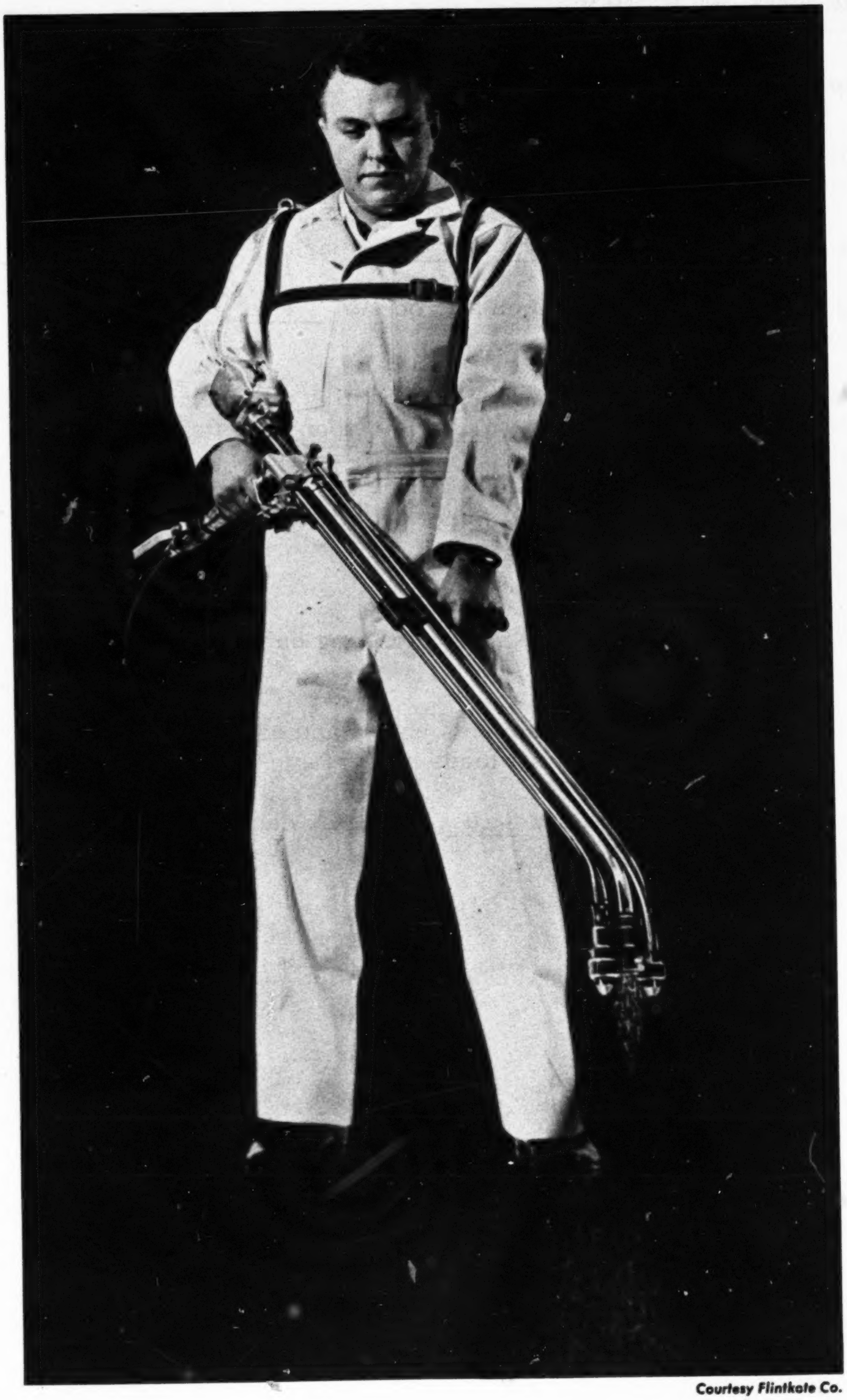
Air compressors. Air compressors are used in roofing to operate spray equipment (such as small air guns) and gads, and for dusting roofs that are to be reroofed. Occasionally, compressed air is also used to operate small air motors for other roofing equipment.

Spray equipment. Spray equipment is used largely for the application of protective coatings and primers on decks and foundation walls.

Special spray equipment is available for the application of the combination chopped glass and plastic roof material, like Monoform. This equipment chops and sprays at the same time.

Some general instructions and key points to follow in setting up and operating spray equipment used by roofers are: be sure adequate ventilation is available in closed areas; wear protective clothing, mask, and respirator; be sure pressure is not in excess of that required for the material and equipment; never spray when winds can blow the vapors onto finished surfaces; enclose V-belts and pulley drives; and ground all noncurrent metal parts by using 3-conductor cable and 3-pole plugs and receptacles.

Coating brushes. Brushes used for applying roof coatings are specially made. They have long handles and may be either of the three-knot or four-knot type.



Courtesy Flintkote Co.

Fig. 62. Special spray equipment for applying Monoform roofing

Checkup

The minimum gauge of sheet steel that may be used for a bucket to be used for carrying hotstuff is ___ 1 ___.

1. ____________

Roofing mops are made of ___ 2 ___ or ___ 3 ___ fibers.

2. ____________
3. ____________

Roofing brackets are required on all roofs of ___ 4 ___ pitch or steeper.

4. ____________

For spans less than 10', the wooden supporting members between brackets may be 2" × ___ 5 ___. For spans greater than 10', they must be at least 2" × ___ 6 ___.

5. ____________
6. ____________

The use of ladder-jack scaffolds is not permitted by the Construction Safety Orders if the platform is more than ___ 7 ___ above the ground.

7. ____________

To remove the asphalt that clings to a stapling hammer, soak it in ___ 8 ___.

8. ____________

Of the two types of lifting equipment, hoists and conveyors, ___ 9 ___ can generally lift loads higher.

9. ____________

When using electric sprayers, ___ 10 ___ conductor cable is required for safety.

10. ____________

unit D

ROOF PREPARATION

The work in units A, B, and C provides the apprentice opportunity to acquire considerable information basic to the roofing trade--the tools and equipment used and the safety rules followed. Beginning with this unit he is given opportunity to learn how to use this information to advantage in the roofing trade.

In learning to use the basic information he has acquired, the apprentice should become acquainted with the practices that are followed in getting ready to apply roofs and acquire the skills used in making the applications.

Getting ready to apply a roof is an important step, for unless this part of the job is well done, trouble may be encountered in applying the roof and the finished roof may be unsatisfactory. An unsatisfactory roof may cause the contractor to assume responsibility that he might have avoided by making a careful examination of the roof and securing the corrections needed before the roofing was applied.

In making an inspection of the roof, an important and necessary step to take before roofing is applied, the roofing contractor or his representative should use the blueprint of the roof as a guide. He must note each detail pictured in the blueprint and make certain that the proper provision has been made.

The apprentice will find information regarding blueprints in the Introduction to Apprenticeship, Unit G, Basic Blueprint Reading, which will be of value to him from this point on. Later in this course he will have opportunity to become better informed regarding the use of blueprints and to become proficient in reading blueprints.

Topic 1— NEW ROOF DECKS

Assignment Strahan, J. L., Manufacture, Selection and Application of Asphalt Roofing and Siding Products, pp. 20-22.

Introduction

The roof deck should be inspected by the roofing contractor or his crew supervisor to determine whether all preparatory construction work has been completed and what work, if any, remains to be done on the deck. If in making this inspection unfinished or improper construction is discovered or flaws are found in the deck, all should be fixed before any roofing is done. Unless this procedure is followed, the roofing contractor may be faced at a later time with the problem of replacing or repairing a roof that should have been satisfactory, and in all probability would have been satisfactory had the necessary steps been taken to have the roof ready for roofing.

Related Information

In making an inspection of the roof of a new building, the roofing contractor or his representative should use the blueprint of the roof to determine (1) what pipes will extend through the deck and the locations of the pipes; (2) where ventilators will be located; (3) where drains will be located; (4) what chimneys or stacks have been installed; and (5) what surface structures, such as supports for electric signs, are required.

Pipes and Vents. Each pipe and vent extending through the roof should be examined to determine whether it is in place and properly installed, and the required jack or flashing is in place or available.

- Plumbing pipes. Plumbing pipes that extend above the roof level are black, pitch-coated iron soil pipes or galvanized pipes that are connected to the sewage system of the building. They are equipped with jacks.

- Conduits. Electrical conduits that penetrate the roof require jacks or flashings wherever such penetration occurs. Although lead is sometimes used for this, the trend is toward the use of elastic flashing materials.

Ventilation outlets. Ventilation outlets vary in size and sometimes terminate in a gooseneck, hood, or mobile unit. Jacks or flashings are not always needed with them, because some have their own flanges to keep out water. However, when these flanges are used they must be secured to the roof in a water-tight manner.

Drains. Decks for flat roofs should always be leveled properly to insure the free drainage of water. In addition, the roofer must be sure that all drainage connections will permit the free flow of water, with all drain outlets set flush with the roof deck. On a flat roof, the overflow should be close to the outlet and about two inches higher than the lowest part of the roof. On an enclosed roof with a steep pitch, the overflow should be raised to compensate for the slope. The following table is provided to help determine the proper outlet size for various roof areas:

TABLE 1

OUTLET SIZE REQUIREMENT FOR GOOD DRAINAGE

Diameter of Drain	Areas the Pipe Will Drain When Laid at Grades of:	
	1/4" per foot	1/2" per foot
3"	1, 200 sq. ft.	4, 500 sq. ft.
4"	2, 500 sq. ft.	5, 200 sq. ft.
5"	4, 500 sq. ft.	6, 000 sq. ft.
6"	8, 000 sq. ft.	10, 000 sq. ft.
7"	12, 400 sq. ft.	15, 000 sq. ft.
8"	18, 000 sq. ft.	22, 500 sq. ft.

Chimneys and stacks. Chimneys are generally constructed of brick or stone, while stacks are made of metal or metal-jacketed products. In addition, it is usual for stacks to have weather caps attached. Both chimneys and stacks must be flashed or jacks used for waterproofing.

Surface structures. Surface structures may include any of those items placed on a roof deck after the structure has been completed. They may include such things as legs to support a sign, the base for a flagpole, or an air conditioning unit. The roofer should make certain these items are properly installed on the deck prior to roofing around them.

Flashing and cant strips. Check to see that all required saddles, crickets, washbacks, and cant strips have been installed. Saddles, crickets, and washbacks are diverters placed on the high side of skylights, chimneys, and similar vertical structures to direct the flow of water away from the obstructions. Cant strips may be installed to protect the base flashing wherever a vertical rise occurs. If cant strips are of wood, they are applied before the roofer begins his work; if they are of fiberboard, they are part of the roofing application. Parapet walls are sometimes used around steep roofs, generally along the rake. This requires the use of step flashing and the procedure to be used in these cases will generally be found in the job specifications.

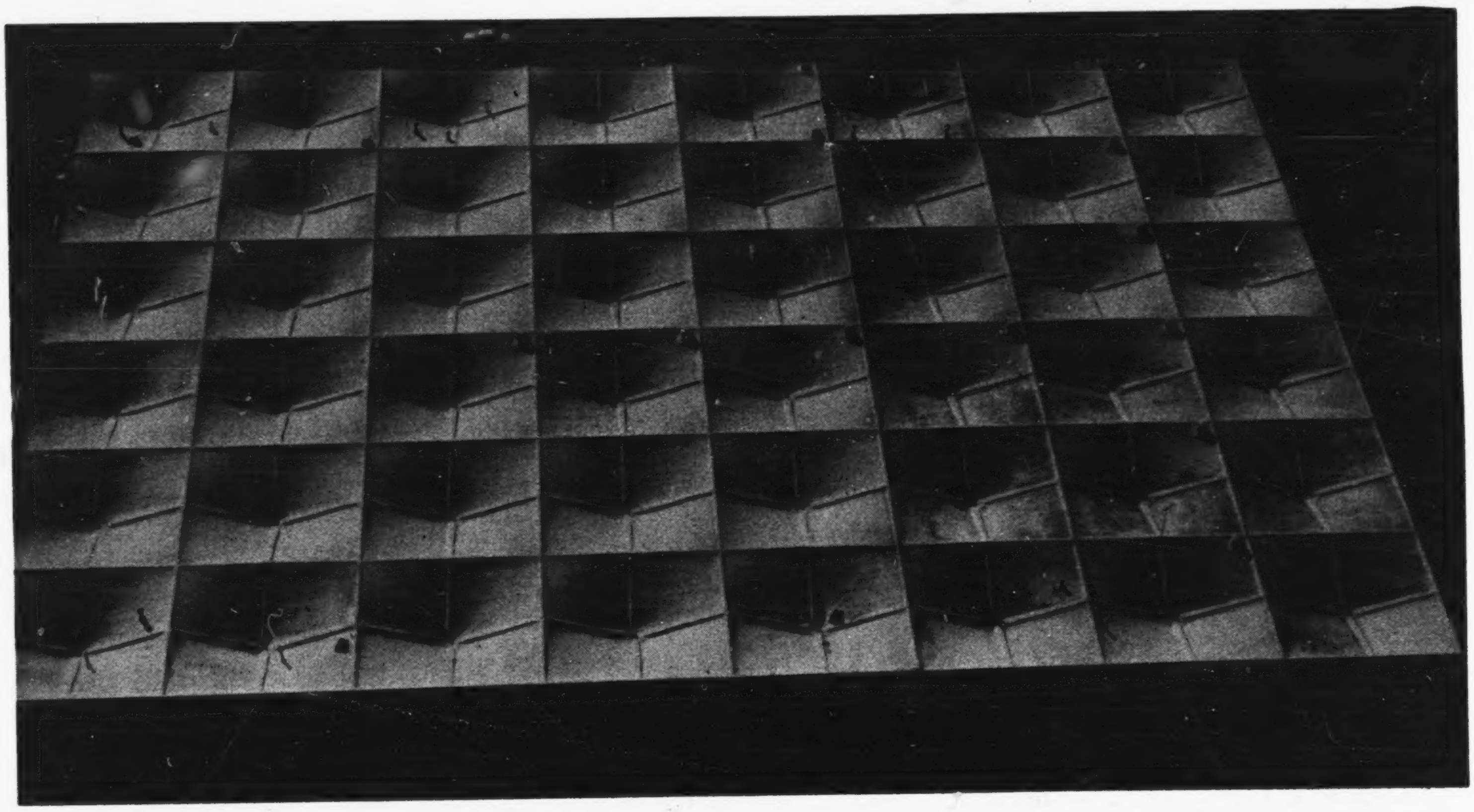
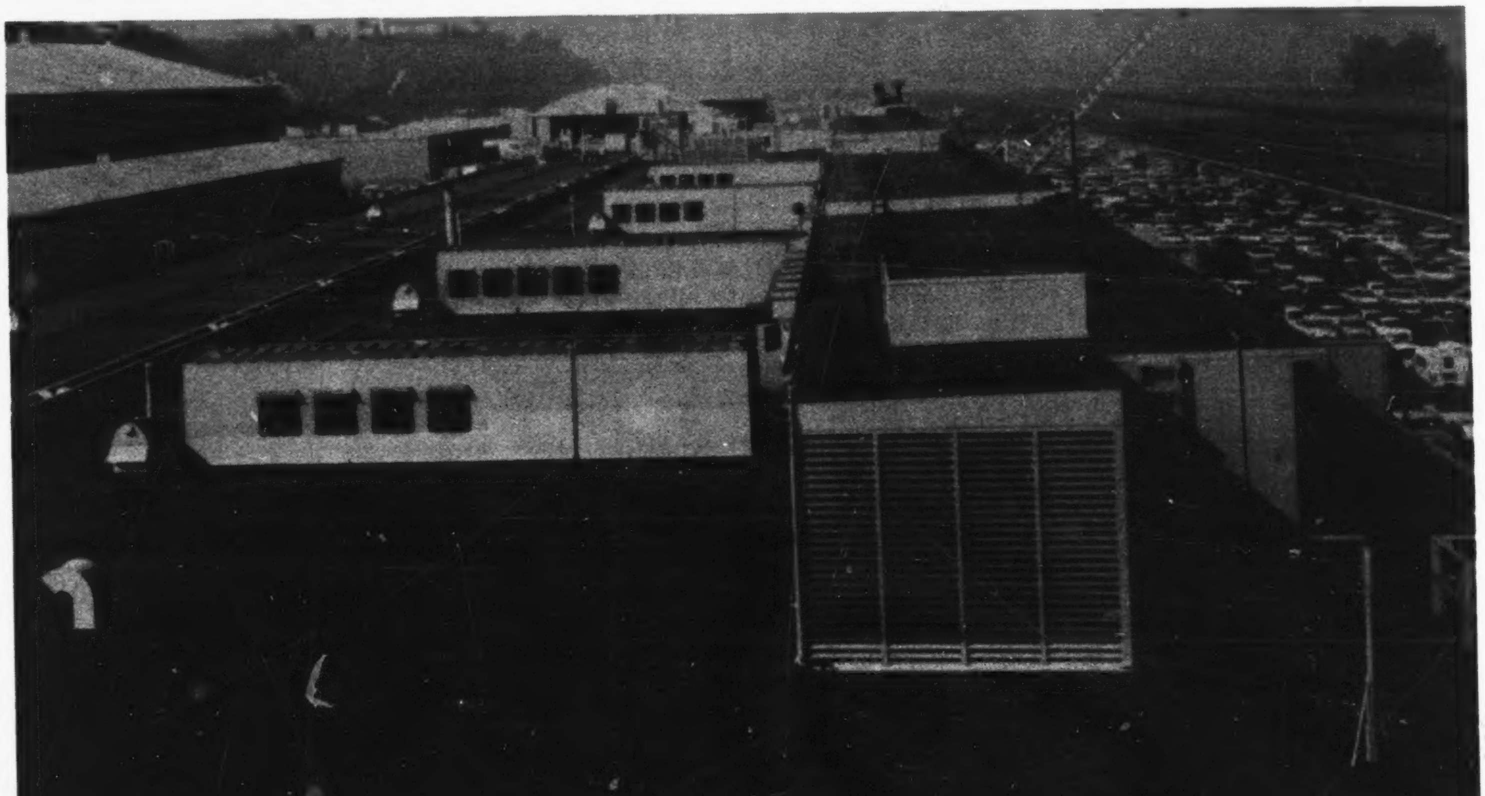


Fig. 63. A thin-shelled concrete roof structure covered with Monoform roofing system and a reflective coating to reflect the sun's rays



Courtesy Flintkote Co.

Fig. 64. A flat roof covered with Monoform roofing system. On the deck may be seen a number of roof obstructions, such as vents, pipe braces, railings, and air conditioning condensers

Wood or Plywood decks. All sheathing boards should be dry, smooth, and free from large knotholes and cracks. If there are large knotholes or holes with loose knots, these should be covered with metal, nailed down before roofing material is applied. All sheathing boards should have a bearing and any curled edges must be nailed down securely if a good roof surface is to be attained. A nailing schedule that may be used as a guide is given in the following table. It shows the number of nails to be used on each bearing for the size of the board used:

1" × 4" ---------------- two 8d common
1" × 6" ---------------- two 8d common
1" × 8" ---------------- three 8d common
1" × 10" ---------------- three 8d common
1" × 12" ---------------- four 8d common

If thin plywood is used for decking, the joints must be blocked to avoid possible edge movement that will result in roof damage.

Concrete or gypsum decks. A concrete or gypsum deck must be smooth, firm, thoroughly cured, free from frost or the effects of freezing, properly leveled, and free from all debris prior to the installation of a roof. If the deck is found to be rough, any high spots--such as sharp ridges or other projections--must be removed and any low spots filled with portland cement or gypsum mortar. This kind of preparation is done by the deck contractor. On precast concrete slabs, all joints must be filled with mastic by the roofer

Checkup

The plans and specifications should be checked before a new job is started. 1. T F

The overflow on flat roofs should be 2' higher than the the lowest point on the roof. 2. T F

Large knotholes in a roof deck should be covered with metal. 3. T F

A drain outlet on a 25-square roof graded at 1/4" per foot should be 3" in diameter. 4. T F

Sheathing that is 1" × 6" should be nailed to each rafter with two 8d common nails. 5. T F

On a precast concrete deck, the roofer should fill all cracks with mastic. 6. T F

A low spot on a concrete deck should be filled with asphalt. 7. T F

Vent pipes often have weather caps on them. 8. T F

Cant strips are used in place of crickets and saddles. 9. T F

Topic 2— REROOFING JOBS

Introduction

Reroofing jobs represent a very large and important segment of the roofing industry today. In the majority of cases, the new roofing is applied over the old one, but this is not always possible in the case of badly deteriorated or damaged roofs. Whether to remove the old roof or not is generally decided by the customer, usually on the advice of the roofing contractor who is best qualified to determine the condition of a roof.

Many conditions and circumstances will go to make such a determination, however, and the appropriate procedure to follow in each case will vary from job to job. This topic is devoted, therefore, to a general discussion of these conditions and the procedures used in reroofing jobs.

Related Information

Inspection

When inspecting an existing roof prior to reroofing, the following items should be checked:

- Vertical structures on the roof for structural cracks that might cause leaking, defective flashings in need of replacement, or the addition of cant strips.

- Drain outlets, pipes, vents and other projections for possible replacement as well as defective, missing, or otherwise inadequate flashings.

- Existing roofing material, looking particularly for alligatoring, splits, evidence of standing water, buckles and blisters, decomposition, shelling, and missing or broken tiles and shingles.

- Equipment installations in the roof for inadequate flashings or other conditions that might cause leaking or interfere with the application of the new roof. Any obsolete equipment on the roof should be removed at this time.

- Weak or broken members of the roof structure that should be repaired or replaced prior to reroofing.

Preparation

Roof re-covering. If it has been determined that the new roofing may be applied over the old, the following preparatory steps should be taken:

- If the existing roof is covered with gravel, spud or scrape off the gravel so as to achieve a reasonably smooth surface. Sharp gravel left on the roof will often cut through the new covering and cause leaks. Spudding on large roof areas is sometimes accomplished by using a spudding machine. (See Fig. 61, Topic C-6)

- Cut all buckles and blisters with a knife in the form of a cross. Smooth out and feather the edges of the four segments so that they will lie flat and butt properly. Then nail securely around the edges with large headed roofing nails.

- Spud off fishmouths, wrinkles, and rough spots caused by previous patching. These defects are usually on the cap sheet only and can be removed easily with a spudding bar.

- Fill in all low spots on a flat roof with asphalt or felt and level the surface of these areas. This will lessen the chance of water puddles being formed on the new surface and will improve drainage.

- Remove any nails which protrude through the old roof. Such nails, if left in, may eventually pierce the new covering and cause leaks.

- Where cant strips do not exist at the base of parapets, firewalls, and similar vertical structures, the old roofing may have shrunk and pulled away from the corners. To correct this condition and prevent a recurrence, break the old roofing in these spots with a heavy spudding bar so that when the new material is applied, square corners can be made or cant strips installed if desired.

- Flashings that are defective or inadequate should be removed for replacement. Drain outlet boxes should be removed at this time also, and the old roofing cut away about three feet around the drain. The removal of old mastic and asphalt from the metal flanges around the drain is also essential, since this will eliminate the chance for a build-up to occur around the drain outlet box when the new roofing is applied. If the outlet box is defective, replace it; if not, slide a layer of 15 lb. felt under the flanges prior to nailing back down. This will result in the felt, the flange, and the new roof being all bonded together when the job is completed, thereby insuring a waterproof job.

- Scrape off all plastic, mastic, fabric, Irish felt, and asphalt from around pipes and vents. This will insure a firm bond of the new roof to these metal surfaces. Collar the pipes on the deck with a piece of cap sheet large enough to extend 6" around each pipe. Where metal roof jacks are used around vents and excessive rust or deterioration is present, replace them. Rusted or defective metal coping on firewalls should be removed for replacement.

- Stucco or masonry walls are often flashed with plastic or 3-course flashing. Wherever this is found, remove this material with a spudding bar, then prime the top of the wall with a good primer. If the wall has been covered with tile coping, this should be removed so the new roofing can be applied up and over the top of the wall or flashing can be applied prior to re-installing the coping.

- If the reglet flashing on a wall or chimney is in bad condition, it should, of course, be replaced. Quite often, however, such flashing is usable and it is only necessary to pull it away from the wall enough to allow the new roofing to extend up and under it. The flashing should be pushed back down; nailed securely, and sealed with mastic or plastic cement.

A steep roof, of course, does not require the same amount of preparation as one that is flat. On composition roofs, for example, it has only to be swept to remove any substantial amounts of loose granules and any loose, protruding nails should be removed or driven back in place. Missing shingles should be replaced to provide a uniform surface on which to reroof. With that, the new application of shingles can begin.

Rigid roofing, however, must always be removed before any new covering is applied, unless the work order calls only for repair. In that case, only broken pieces are removed for replacement.

Roof removing. If a roof is to be removed before the application of a new covering, one of the first considerations must be the best and safest place to lower the old roofing material to the ground. It should be a place that is free of obstacles, away from foot or vehicular traffic, and easily accessible for a truck to haul the material away. Great care must be taken to avoid injury to persons on the ground or damage to the side of the building during the lowering process.

After all the old roofing has been removed, check the sheathing for protruding nails which should be pounded flush or removed. The sheathing should then be cleaned of loose dirt and gravel or any deposits of pitch or asphalt. Broken, warped, or weak sheathing should be replaced before application begins.

Checkup

Good reroofing practice requires that the gravel on a roof be removed before the new roof is applied. 1. T F

Buckles and blisters are cut in the form of a cross and nailed down securely. 2. T F

Fishmouths and wrinkles are cut off with a sharp knife and nailed down. 3. T F

Low spots are of no concern to the roofer, because the new roofing will cover them. 4. T F

Nails may be left protruding through the old roofing. 5. T F

By cutting the rounded angles at a firewall or parapet, the roofer can make a square angle on the new roof. 6. T F

A stucco or masonry wall should be scraped and primed before applying new material. 7. T F

Tile coping need not be removed prior to applying new roofing material. 8. T F

unit E

KETTLES AND KETTLE OPERATION

The importance of skillful kettle operation is too frequently underestimated by the employer and the apprentice. It is sometimes falsely contended that a good place to start a beginning apprentice is on the kettle. This is a serious mistake which has cost many thousands of dollars in loss of time, in injuries, and in roof failure.

An apprentice should never be assigned to kettle work until he has been made familiar with the operation, and then only under the close supervision of a competent journeyman. Prior to actually trying his hand at kettle operation, the apprentice should become familiar with the safe handling of asphalt, observe the various methods of kettle operation, and learn the particular function of different kinds and types of kettles.

This unit will provide the apprentice with basic information which is not usually taught on the job, and must therefore be learned in the classroom. A good kettleman has this information plus much more which he has gained from many years of experience.

Catalogs, literature, and specifications issued by the various kettl manufacturers, such as Blackwell, Aeroil, Roofmaster, and Cleasby-Wittig, are the most useful references for the topics in this unit. These may be obtained from local distributors or by writing to the manufacturers.

Topic 1— TYPES OF KETTLES AND BURNERS

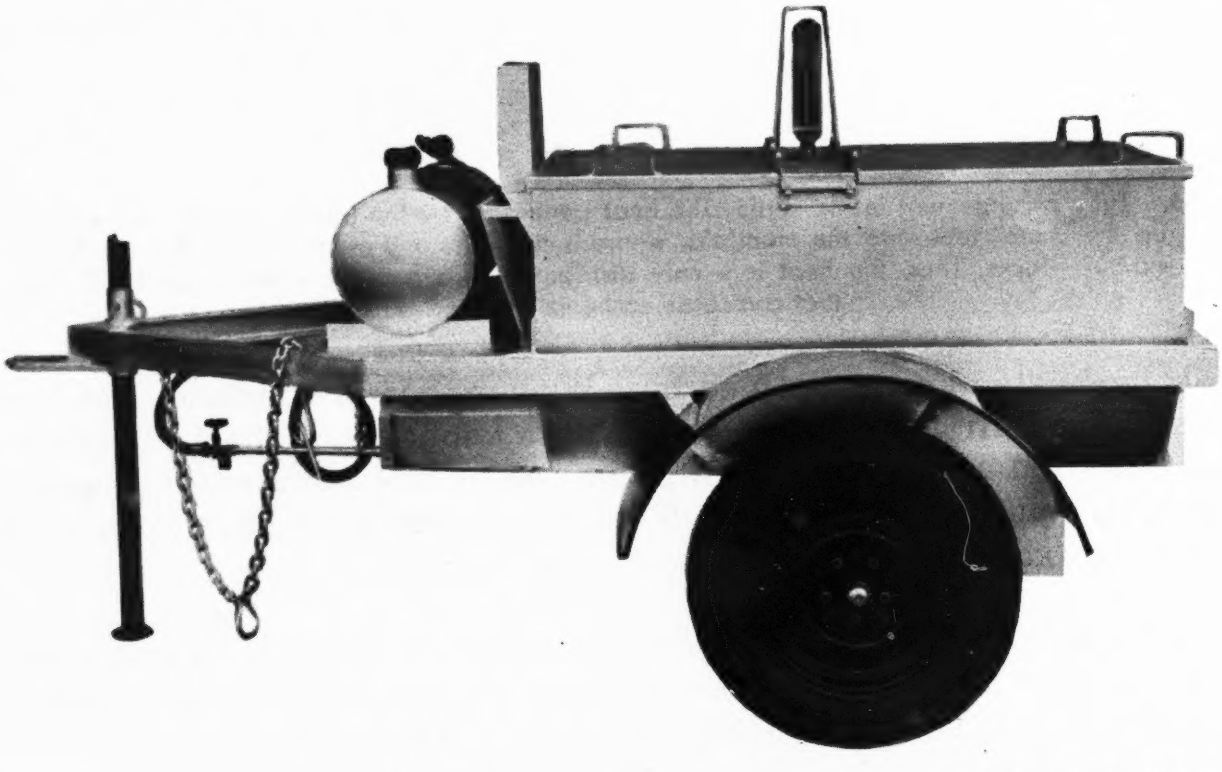
Assignment ⋮ Catalogs and literature from kettle manufacturers.

Introduction

Several types of kettles are used for heating bitumen. Of these, the most commonly used are the kerosene and liquid petroleum (butane or propane) kettles.

Related Information

Bottom-fired kettles. Bottom-fired kettles are seldom used for roofing work because they take too long to heat. This type of kettle is so constructed that heat can be applied directly to the bottom of the inside shell which holds the bitumen. Such kettles are commonly used, however, for heating bitumen for



Courtesy Cleasby-Wittig Co.

Fig. 65. Typical bottom-fired kettle

wrapping pipe with corrosion-proof materials, street repair work and, occasionally, for roofing jobs requiring coal tar pitch and asphalt.

Tube-type kettles. Most kettles today use "tube-type" heating. These kettles are constructed so that heat is directed through a tube unit which is submerged in the asphalt (Fig. 66). The tube unit rests in the kettle a few inches from the bottom. This allows the asphalt to surround the tubes completely, giving more even heat distribution and more kettle production.

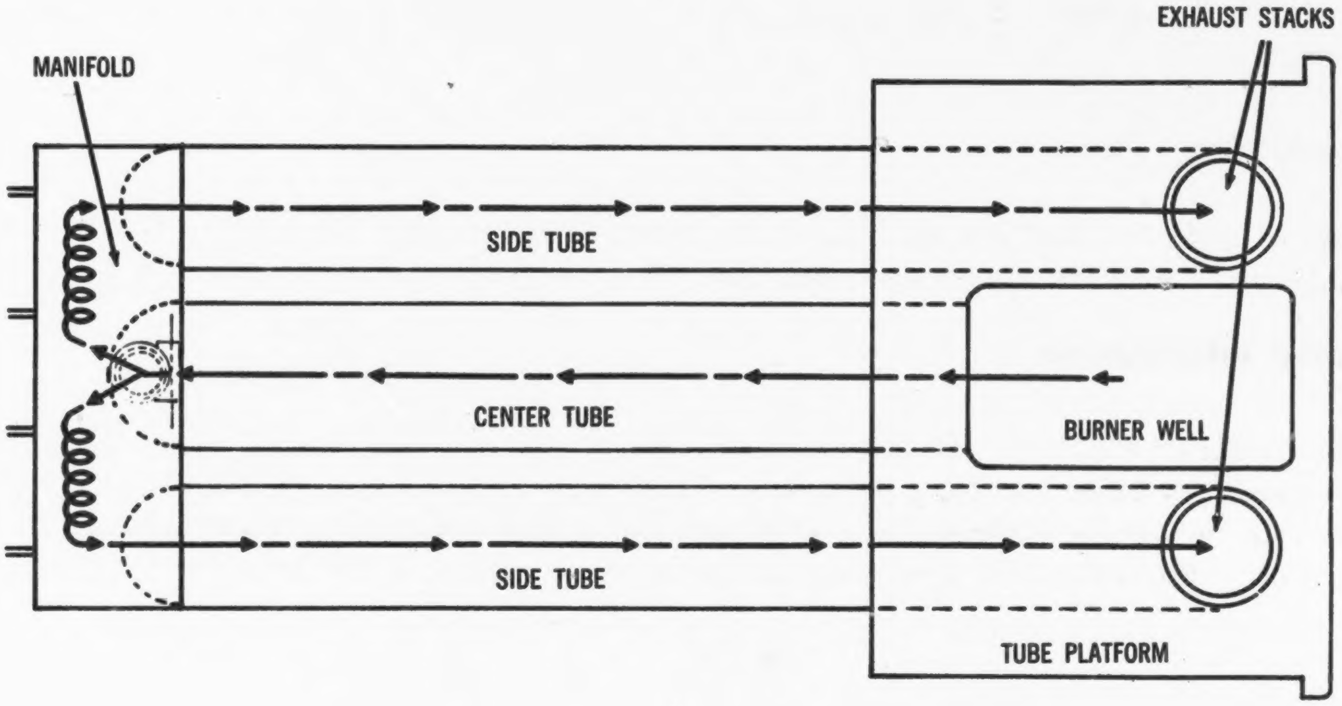


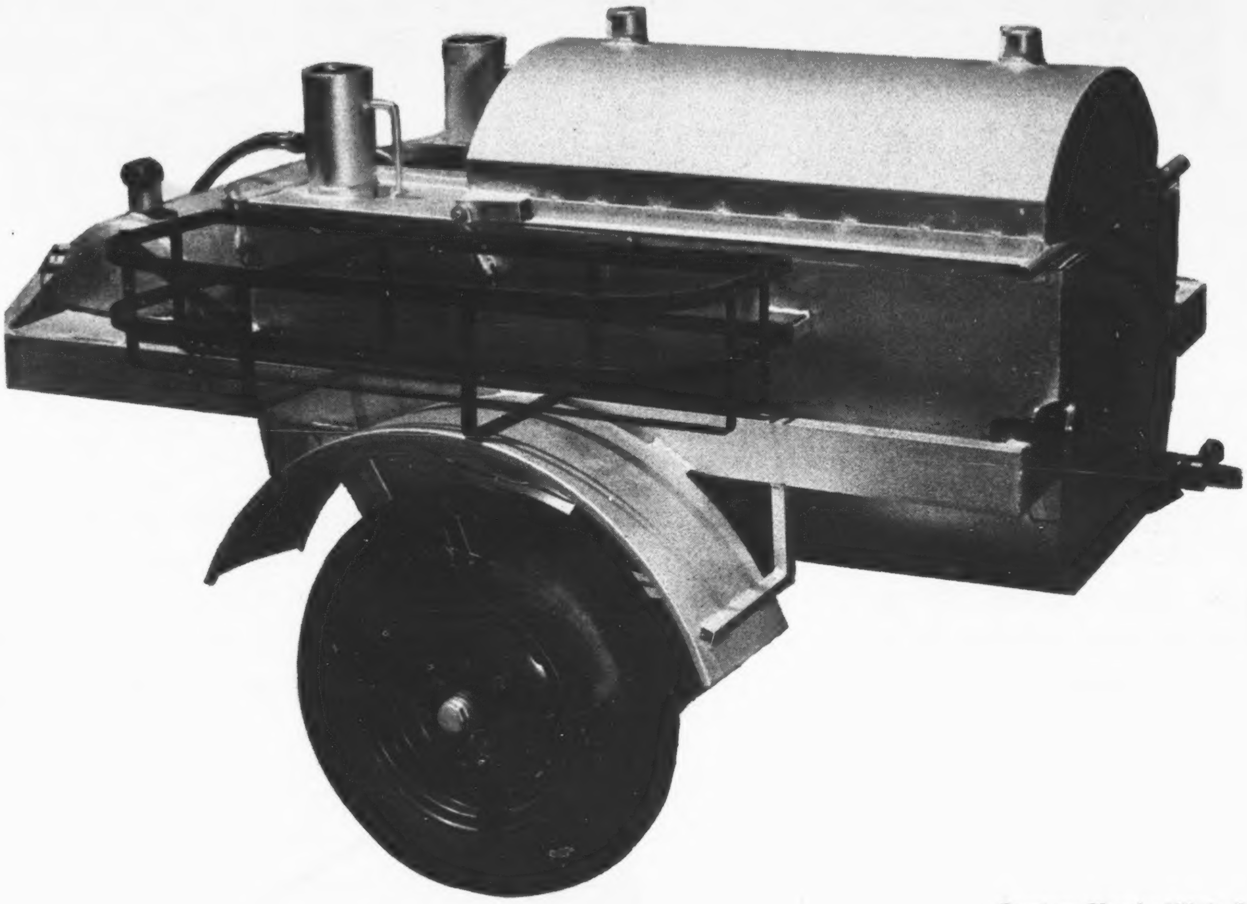
Fig. 66. Tube arrangement inside kettle. The heat generated by the burner (placed in the burner well) travels up the center tube into the manifold, where it circulates and escapes back through the side tubes to the exhaust stacks. Thus, the heat is evenly distributed throughout the kettle, avoiding "hot spots" that can cause carbonizing and flashing

A kerosene-heated kettle is fired by a burner that is supplied with a mixture of kerosene and air from a fuel tank with a capacity of about 20 gallons. Protruding into the tank is an air pump that is operated by hand in a way similar to the way a tire pump is operated. This allows the air to mix with the kerosene, forcing the mixture through a hose into the burner.

A shut-off valve is located at the hose connection of the tank and a strainer valve at the burner. The valve on the tank should be fully open when operating and closed when not operating the kettle. The valve on the burner is for straining the fuel through a screen and for adjusting the size of the flame. Both valves act as safety devices, since closing either one will shut off the burner. The tank is also equipped with an air gauge to indicate the amount of air pressure in the tank, usually about 30 lb., depending upon the size of the burner. Larger burners generally require more pressure to operate.

The burner itself consists of a steel coil surrounded by a metal shell. The size of the coil and the number of coils vary. Small burners have fewer coils than larger ones and do not generate as much heat. Small burners are used mainly for patch work and small kettle operation.

Kettles heated with butane or propane (LP gas) burners are constructed the same as kerosene-fired kettles; however, the butane burner differs from the kerosene type in that no coils are necessary. The gas is fed directly to the outlet burner tip where it mixes with oxygen from the air.



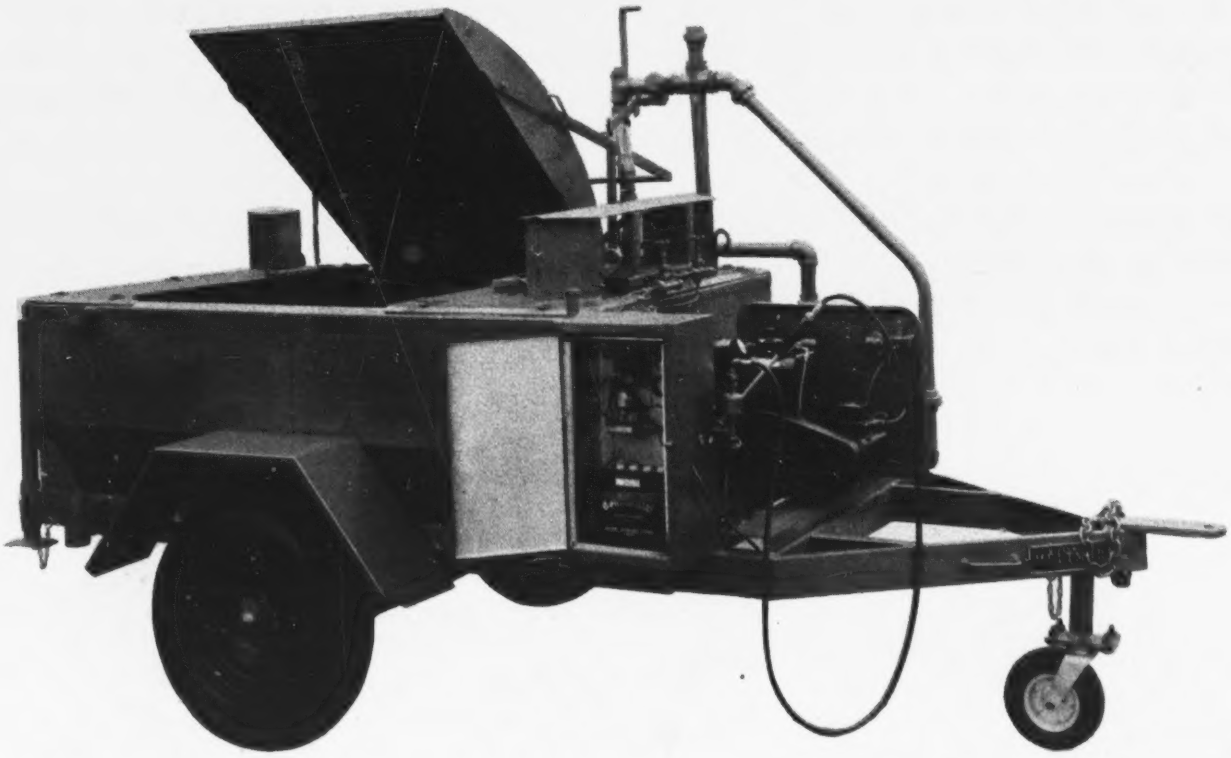
Courtesy Cleasby-Wittig Co.

Fig. 67. 140-gallon tube-type kettle

Automatic kettles. The automatic kettle is relatively new to the roofing industry but is already in general use throughout the country. This kettle is equipped with automatic heat controls.

The advantages of automatic controls are many, but the most important is that overheating can be completely prevented. This eliminates the need for the constant attention of the kettleman to the cooking process.

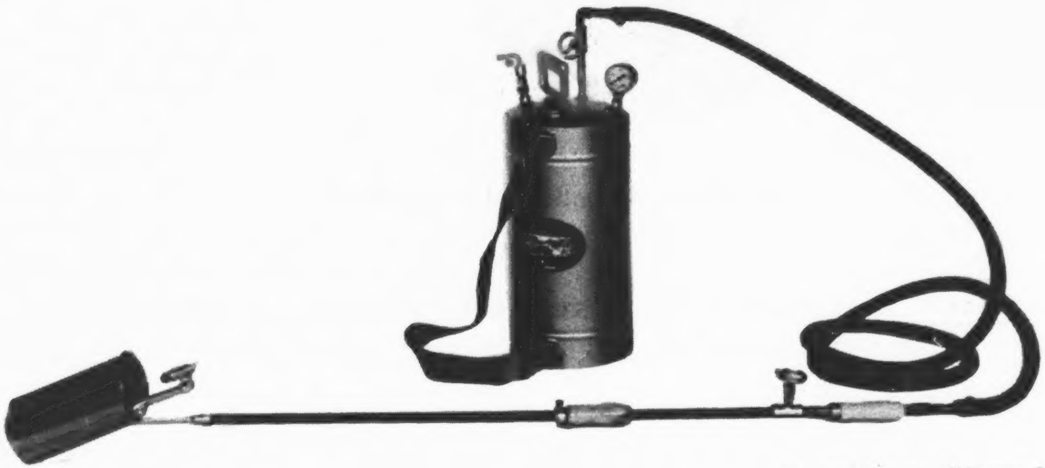
This type of kettle is fired by LP gas (propane or butane).



Courtesy Roofmaster Products Co.

Fig. 68. One type of automatic pump kettle

Weed burners. Weed burners are similar in construction and operation to the burners used for heating kettles, but they are not interchangeable. Weed burners are small, portable burners, usually using fuel from a small tank carried on the shoulder and are used most frequently for drying off small portions of a damp or frosty roof to prepare it for the application of roofing.



Courtesy Blackwell Burner Co.

Fig. 69. Weed burner setup showing fuel tank, pressure gauge, and generating pan

Weed burners are also used for heating pumps and pump-piping to melt the bitumen that has hardened inside so that hotstuff can be pumped through them.

Checkup

Bottom-fired kettles are equipped with tubes. 1. T F

A beginning apprentice should start on kettle work. 2. T F

Most kettles used today are of the tube type. 3. T F

A kerosene heated kettle is fed by butane. 4. T F

Propane burners are impractical for heating kettles. 5. T F

At least 100 pounds of air should be pumped into a kerosene fuel tank. 6. T F

Weed burners are used on the roof primarily for burning off spilled bitumen. 7. T F

The flame on a kerosene burner seldom needs to be adjusted. 8. T F

The air gauge on the tank indicates the amount of fuel in the tank. 9. T F

Butane or LP burners require smaller coils than do kerosene types. 10. T F

Topic 2— LIGHTING AND LOADING KETTLES

Assignment ⋮ Catalogs and literature from kettle manufacturers.

Introduction

Efficient and safe operation of kettles calls for skills and attentiveness to an even greater extent than is required for other roofing jobs. There is no reason for burns, fires, property damage, or warped kettles if the proper practices are employed in lighting burners and in loading and operating kettles. In addition to the material presented in this topic, every apprentice should study carefully that section of the safety code reviewed in Topic A-2 on safe kettle operation, and the applicable sections of the Construction Safety Orders and Safety Rules for Roofers (Bulletin 124, Department of Industrial Safety).

Related Information

Lighting Burners

Kerosene burners. The proper procedure for lighting a kerosene burner is as follows:

1. Fill the kerosene tank, but never to capacity; allow sufficient air space above the fuel. Replace the filler cap firmly, using hand pressure only.
2. Use the hand pump to build up the air pressure inside the tank until the gauge reads approximately 30 pounds.
3. Open the valve on the tank (not on the burner) as far as it will go.
4. Open the valve on the burner about 1/4 turn, or just enough to allow the raw kerosene to trickle into the burner pan.
5. Shut off the burner valve when the burner pan is half full.

NOTE: In this operation, the burner should be placed on the ground. Do not open the valve too wide, as a stream of raw kerosene may shoot out and flood the area. Should this happen, move the burner to a new area, well away from the spilled fuel before lighting the burner.

6. Saturate a small piece of paper or cloth with kerosene and place it into the burner to act as a wick.
7. Light this wick and wait for it to ignite the kerosene in the pan. The flame will heat the generating coils that contain kerosene supplied from the fuel tank. When the coils become hot enough, the kerosene contained within the coils vaporizes and, as the pressure of the vapor increases, the vapor enters the orifice tip and ignites. A blue, roaring flame is produced. The whole process is then said to be "generating." After a full flame emits from the burner and is generating properly, open the valve on the burner slightly to adjust the flame. When the excess kerosene in the pan has burned out, place the burner in the burner well and adjust the flame for the required heat. An adjustment in air pressure may also be required.

Butane and propane burners. Burners of the propane or butane type (usually referred to as LP gas or LPG) are not as difficult to operate as kerosene burners; however, they still require a competent kettleman to operate them.

LP gas (liquified petroleum gas) is supplied in high pressure cylindrical tanks called "gas bottles." Those used by roofers are generally of the 25-gallon size, but those serving larger kettles may be 100- or 200-gallon capacity. These larger tanks may be filled right on the job by an LP gas tank supply truck.

Recommended Pressures for LP Gas Kettles

Kettle size (gallons)	Recommended pressure (pounds)
30	10-15
55	20
85	25
115	25
140	25
175	30
230	35
330-350	35
540	35-40

Gas bottles should be equipped with pressure regulators, for the initial pressure of the gas is at least 100 pounds. The regulator allows the gas to flow from the bottle to the kettle burner at a lower rate of pressure, such pressure determined by the size of kettle being fired. The hose connecting the regulator to the kettle burner must be of the approved type, manufactured specifically for use with LP gas. Hose fittings must never be allowed to become bent out of shape or loose.

When using LP gas it is necessary to open the valve on the gas bottle all the way, then open the burner valve just enough to release sufficient gas so that the burner may be lighted. Some LP gas burners are equipped with pilot lights so the burner may be turned off when the kettle gets hot and relighted by the pilot when needed.

It is not a safe practice to idle a gas burner down to the point where the flame is not strong enough to flow completely through the center tube. Too small a flame will create hot spots along the center tube that may lead to flashing.

Automatic kettles. Automatic kettles operate on LP gas. The pilot light is lit first and acts as a pilot generator, developing sufficient electricity to hold the safety valve open. The thermostat is then set to the desired temperature and the burner goes on automatically. It stays on until the bitumen reaches the proper temperature. At this time the burner goes off and remains off until the temperature of the bitumen drops by about 13° F. Then the burner goes back on and this cycle continues until the burner is shut down.

If for any reason the pilot light is extinguished, the safety valve immediately cuts off the flow of gas to the burner to prevent raw gas from escaping.

Kettle Loading

Tube-type kettles. Proper loading of a kettle is as important as any skill in the roofing trade. If the kettle is empty, or nearly so (that is, when the tubes are exposed above the bitumen), the kettle should not be fired up without first adding sufficient bitumen, chopped into small pieces (about baseball size), around and well over the tubes. The burner may then be placed in the burner well with a low flame. This will start the bitumen melting gradually without flashing or burning. If a high flame is used, the bitumen may ignite before it is melted.

After the bitumen in the kettle is melted, additional chunks of slightly larger size may be added until the kettle is about 3/4 full. This method will allow space for additional bitumen should the kettle become overheated. It will also decrease the danger of flashing due to overheating.

When the bituman is completely melted, the flame should be adjusted to maintain an even heat. This should be done by regulating the valve on the burner--NOT the valve on the tank. In actual practice, the tank valve should always be wide open and the flame should be adjusted only at the burner valve. Most kettles are equipped with a thermometer that shows the temperature of the liquid. As hot bitumen is drawn off, additional chunks are fed into the kettle in order to maintain the proper level. The burner flame may need to be adjusted from time to time, depending on the thermometer reading during draw-off and feeding periods.

A good kettleman will always have an ample supply of bitumen chopped and ready for feeding, so that when there is a large draw of hotstuff, he can immediately bring the kettle load up to the desired level. A kettleman who has learned to coordinate drawing off, feeding, and uniform temperature can keep a crew of roofers supplied with hotstuff.

If a kettle is partly filled with cold bitumen in solid form when the kettle is to be lighted for the day's work, and the tubes are well covered, the same lighting procedure must be followed as previously explained, except that no bitumen need be added until the bitumen present has melted.

Bottom-fired kettles. Extreme care must be taken when heating a bottom-fired kettle. This type allows for direct heat to be supplied to the bottom of the kettle, which often causes the bitumen at the bottom to overheat while that at the top is still cold. This will often cause a kettle to flash or explode, since the trapped gases cannot escape. Consequently, only a low flame should be used with this type of kettle, and the bitumen should be agitated so as to distribute the heat as quickly as possible.

Checkup

A kerosene tank should always be filled no less than 3/4 full. 1. T F

LP gas burners are easier to operate than kerosene burners. 2. T F

LP gas burners require no generating. 3. T F

A low flame should be used if kettle tubes are exposed. 4. T F

Before heating, the kettle should be loaded at least 3/4 full. 5. T F

An automatic kettle requires no hand loading. 6. T F

Topic 3— HEATING KETTLES AND BITUMENS

Assignment Catalogs and specifications from manufacturers.

Introduction

The heating and melting of bitumens are an important aspect of kettle operation, for the kettleman plays a major part in achieving the desired durability of the completed roof assembly. Kettle design and construction have progressed over the years from crude wood-fired units to fuel oil, kerosene, and gas; from bottom-fired kettles to tube-type units, and from guesswork temperature control to highly accurate automatic heat controls. The result has been the modern engineered high-temperature, fully insulated kettle that serves today's roofing needs.

These modern kettles, when properly maintained and operated, will produce hot material in sufficient quantities to keep pace with other labor-saving methods and devices that are now employed in the application of built-up roofs.

Improper operation, on the other hand, will nullify many of the advantages now offered by today's equipment. In the following paragraphs, some of the problems involved in kettle operation are discussed.

Related Information

Overheating bitumen. Roofing materials manufacturers have set specific temperatures to be maintained if the bitumen is to give the required service and longest roof life. If asphalt is heated over 400° to 450° F (considered to be a safe range), the more volatile oils will be driven off in the form of vapors--and the loss of these oils will cause the asphalt to carbonize and become brittle, thereby drastically shortening the life of the roof.

Coal tar pitch should never be heated over 400° F. Above this temperature, loss of vapors begins to occur at an inverse ratio for each degree of rise, since these oils are even more volatile than those in asphalt. Among the chemicals dissipated in this way are napthalene, phenol, and carbolic and creosote oils, which are the life-giving properties of pitch.

In addition to the loss of useful life, another result of overheating pitch and thus releasing these chemicals in vapor form is severe irritation to skin. The kettleman and the moppers will be exposed to these fumes, which cause burning of the hands, face, neck, and any other unprotected areas of the body. Protection from this danger is discussed in Unit A, Topic 2 of this workbook.

These escaping vapors usually have a yellow-green appearance. Should they turn a vivid orange color, the kettle can be expected to flash. When this happens, the burner should be turned off immediately and the kettle lid closed to cut off the oxygen. After the fire is extinguished, extreme care should be used when opening the lid, for escaping vapors may flash again. After the lid is opened, small chunks of coal tar should be added to help lower the temperature. The burner should not be relit until the kettle has cooled well below flash point.

Results of overheating. Overheating damages the kettle, causing tubes to warp and leak, which allows molten asphalt to enter the fire chambers creating a dangerous condition. The kettle shell itself may warp out of shape as a result of severe overheating and resultant flashing. For this reason a kettleman should keep the outer surfaces of the kettle clean, since the accumulation of pitch and asphalt on the outer shell and tires of his kettle is one of the largest factors in creating this hazard. Once the tar on the outside of a kettle begins to burn, it is almost impossible to extinguish. Such fires will often damage equipment to the extent that replacement of parts will be necessary, or even the loss of the equipment. A cardinal rule in roofing can be stated simply: "A clean kettle won't burn."

Excessive heat in kettle operation is also the cause of carbon formation around the tubes, resulting in heat loss, much longer heating time, and an increased danger of fire. Both fuel and man hours are wasted when this condition prevails.

The kettleman has full responsibility for taking the steps required to keep the kettle from overheating.

Importance of kettle size. Overheating is frequently caused by using a kettle too small for the job. The usual result is that the kettleman is tempted to "push" the operation, in an attempt to run too much material through in too short a time. To do this, he must raise the bitumen temperature well above normal level, and this will result in overheating the bitumen. Either more than one kettle should be used to reduce this demand or, if possible, a single, larger-capacity kettle should be substituted.

On any job requiring the delivery of hotstuff as one of the first operations of the day, the kettle should be fired at least one hour before the crew arrives. If the kettle is fired at the same time as the crew arrives on the job, overheating may result as the kettleman "pushes" the burner to get the hotstuff in a hurry.

Overheating is also caused by a kettleman who does not watch the progress of the roofing operation closely enough and lets his supply of hotstuff get too low. He should know how much of the hotstuff will be required on a particular job and when it will be needed. For example, on a job that is to be "graveled in," he should ask the foreman to notify him at least one hour before pouring operations are to begin so the supply can be made ready.

Rules to remember.

- A fire out of control can cause serious damage to the equipment and the surrounding area. If the fire cannot be controlled at once, call the fire department.
- Use extreme care when adjusting the flame on a kerosene burner. If it has been operating on a low flame and the valve is suddenly opened, the coils may have cooled below vapor-point, causing raw kerosene to be ejected, igniting the surrounding area. (It is not a good practice to operate a kerosene burner on a low flame for a long period of time. The small, yellow flame tends to cause excessive carbonizing of the burner coils.)
- When heating pitch, an approved protective lotion should be used by the kettleman on all exposed skin areas to prevent burning from coal tar fumes.
- Respirators and eye protectors should be used when coal tar pitch is heated or used in confined areas where there is inadequate ventilation.

Checkup

How well a kettleman operates has a direct bearing on the ultimate quality of the roof job being worked on. 1. T F

Heating asphalt to 400° to 430° F will cause distillation and loss of oils. 2. T F

Coal tar pitch, when overheated, produces an acid vapor which can be harmful to exposed skin. 3. T F

Severe overheating or flashing will often warp the kettle tubes, but not the kettle shell. 4. T F

The responsibility of avoiding overheating on a kettle operation rests primarily with the job foreman. 5. T F

Topic 4— CLEANING AND MAINTAINING KETTLES

Introduction

A good kettleman is a systematic workman. Through proper maintenance of his equipment, he can save many dollars in overhead expense and, in addition, can keep jobs on schedule by supplying the required amount of hotstuff when it is needed. Cleaning and maintenance are all part of the kettle operation, and if performed properly will produce efficient operation and delivery. The kettleman can do much to prevent work stoppages and slow-up by making a habit of cleaning his equipment frequently so it is always ready for trouble-free operation when needed.

Related Information

Kerosene burners. Burners should be kept clean and free of carbon if they are to function properly. A burner that has a bent shell, pan, or plugholder will not function as it should. Some rules for long service life are:

- Clean strainer on burner valve periodically.
- Inspect hose fittings. Loose fittings are a fire hazard.
- Clean a dirty burner by removing the vaporizing plug and flushing about a quart of clean kerosene through the coil.
- Do not pound burners on the ground to loosen carbon deposits. This will throw the plugholder out of alignment with the flare tube and coil and loosen the fittings, causing them to leak.
- Keep an extra vaporizing plug and cleaning needle handy.
- Use only a top grade of clean fuel oil or kerosene.

Kerosene tanks. Kerosene pressure tanks do not present any major maintenance problems, but certain precautions should be observed for correct operations. Use only the appropriate filler cap on the tank. Such caps are manufactured so that the air in a tank can be released without completely removing the cap. The backwasher and gasket made specifically for the cap should always be used, and air should never be left in the tank overnight.

The pump is the hardest-working part of the kerosene tank and should therefore be properly serviced. The pump rod should always be pushed straight in--never leaned on. Once the rod is bent, it will always have a kink in it, making it more difficult to push.

The pump leather should be oiled occasionally to keep it from drying out, and it should be replaced when found to be worn or deteriorated. If the neoprene check valve becomes hardened or the spring becomes weak, fuel oil will leak into the pump barrel.

LP burners. LP gas burners (butane or propane) require little maintenance. The tips should be removed periodically to clean out any residue that may have seeped through from the tank. Before lighting, always wipe the burner with a clean rag to remove any accumulated dirt or soot.

Kettles. Kettles should be cleaned at least once a week, and more often if necessary to keep them clean. When the interior of the kettle requires cleaning, it should be "run down" as far as possible on the job and the remaining bitumen run into buckets and set aside. The tubes are removed while the kettle is still hot. The tubes are usually secured to the shell by two bolts on each side of the burner exhaust stacks.

Tubes may be removed from some kettles without removing the lid. It is advisable to use a hoist to lift the tubes from the kettle. Tie a rope or chain from the exhaust stack to the handle on the manifold end of the tubes. Tubes can be lifted straight out or at a slight angle, with the burner-well end slightly higher than the manifold end.

Cleaning of the inside shell should be done at once, since the carbon and sludge are more easily removed while still hot. Scrape down the inside and shovel out the sludge. If the draw-off cock has not been functioning properly, remove and clean or repair it. Clean the kettle screen by scraping and gently tapping on the debris that has accumulated on the mesh.

Use a scraper or spade to remove carbon from the tubes. If there is hard carbon present, remove it on round tubes by gently tapping them with a hammer; on flat-sided tubes, however, scrape it off, since hammering will sometimes cause splits or punctures on this type of tube. Never hammer on an old, weak set of tubes. Wear goggles to protect the eyes whenever such hammering is done.

When reassembling the kettle, replace all defective parts, use extreme caution when replacing the draw-off cock so as not to strip the threads.

The bitumen that was drawn off into buckets at the beginning of the operation may now be poured back into the kettle, providing it is free of sludge; if it is not, simply discard it. The kettle should now be ready for reloading and firing as outlined in Topic 2.

Safety pointers.

- Remove the burner before cleaning a kettle.
- Wear a long-sleeved shirt and gloves during the cleaning process to prevent burns.
- When pouring hot bitumen back into the kettle, take care to raise the bucket high enough to clear the kettle top, and pour slowly and evenly to avoid splashing.

When reassembling, replace all defective parts and do not strip the threads when replacing the draw-off cock.

Checkup

Kerosene burners require no maintenance.	1.	T	F
Excess carbon cannot form in the coils of a kerosene burner if it is properly operated.	2.	T	F
It is a good policy to have extra burners and plugs on hand at all times.	3.	T	F
The kettle should be cleaned only when it is hot.	4.	T	F
Butane and propane burners require relatively little maintenance.	5.	T	F
Hoists are sometimes used to remove kettle tubes for cleaning.	6.	T	F
Carbon should always be knocked off the tubes with a hammer.	7.	T	F
It is seldom necessary to clean the kettle screen.	8.	T	F

Since the fire is out when a kettle is cleaned, no special safety measures are required. **9.** **T** **F**

Cleaning of kettles is required about once a month when they are in continuous use. **10.** **T** **F**

Topic 5— ROOF PUMPS

Introduction

For many years, the only method of hoisting hot asphalt or pitch from the ground to the roof was by hand, using buckets. This was a slow and dangerous method, and nearly 70 percent of all roofing accidents are attributed to the handling of hotstuff in buckets.

Around 1948 a system of pumping hot asphalt was devised using an engine and pump mounted on a frame which sat on the ground next to the kettle. A flexible metal hose was used to draw the asphalt from the kettle to the pump, which then elevated it to the roof where it by-passed a draw-off cock mounted on a roof stand to return on another line back to the kettle. In this way, the hotstuff could be kept circulating through the system and, at the same time, could be drawn off at the roof by using the draw-off cock to supply the material to buckets, carts, or highboys as needed. When the draw-off cock was again closed, the continuous circulation was reestablished. This method of pumping was known as the "double-line" system, and its main drawback was that considerable cooling of the material occurred as it made its way from kettle to roof and back to kettle. This system generally required a larger kettle than would otherwise have been used just to keep the material at usable temperature.

Following this came the development of the kettle-mounted pump with a single line to the roof which greatly increased pump efficiency and lowered costs. This newer, now popular system is fully described in the following discussion on heavy duty pumping systems and submerged pump units.

Related Information

Heavy-duty, single-line asphalt pumping system. The most modern and efficient system yet devised for the elevation of hot asphalt from kettle to roof is the single-line pumping system.

Basically, this system consists of a circulating unit mounted on the kettle. An engine of approximately four horsepower operates the pump, which circulates the hotstuff from the pickup point to the discharge point within the kettle. In this process the hotstuff passes through a line on which is installed a quick-acting valve. Whenever this valve is in open position, continuous circulation takes place.

To elevate the hotstuff to the roof, the roofer simply pulls a control rope to close the line valve. The hotstuff is then directed through a single line to the roof where it is received in whatever receptacle is being used for the purpose, usually a 30-gallon insulated highboy. It takes about one minute to fill such a receptacle. When the rope is released, the quick-action valve on the circulating system is pulled open by a spring on the valve lever and the continuous circulation is once again established. The hot material left in the line is returned to the kettle through a gravity drop and syphoning action.

The supply line to the roof is generally made of thin wall metal tubing, available in lengths of from 5 to 20 feet. Through the combination of different lengths, any desired height can be obtained. At the roof end, a flexible metal hose is used as a filler pipe to the receptacle.

The main advantages of this type of system are:

1. Temperature loss is kept to an absolute minimum, usually running about 10° F for a 60-foot elevation. The hotstuff therefore remains at an easy mopping temperature without having to be overheated in the kettle.

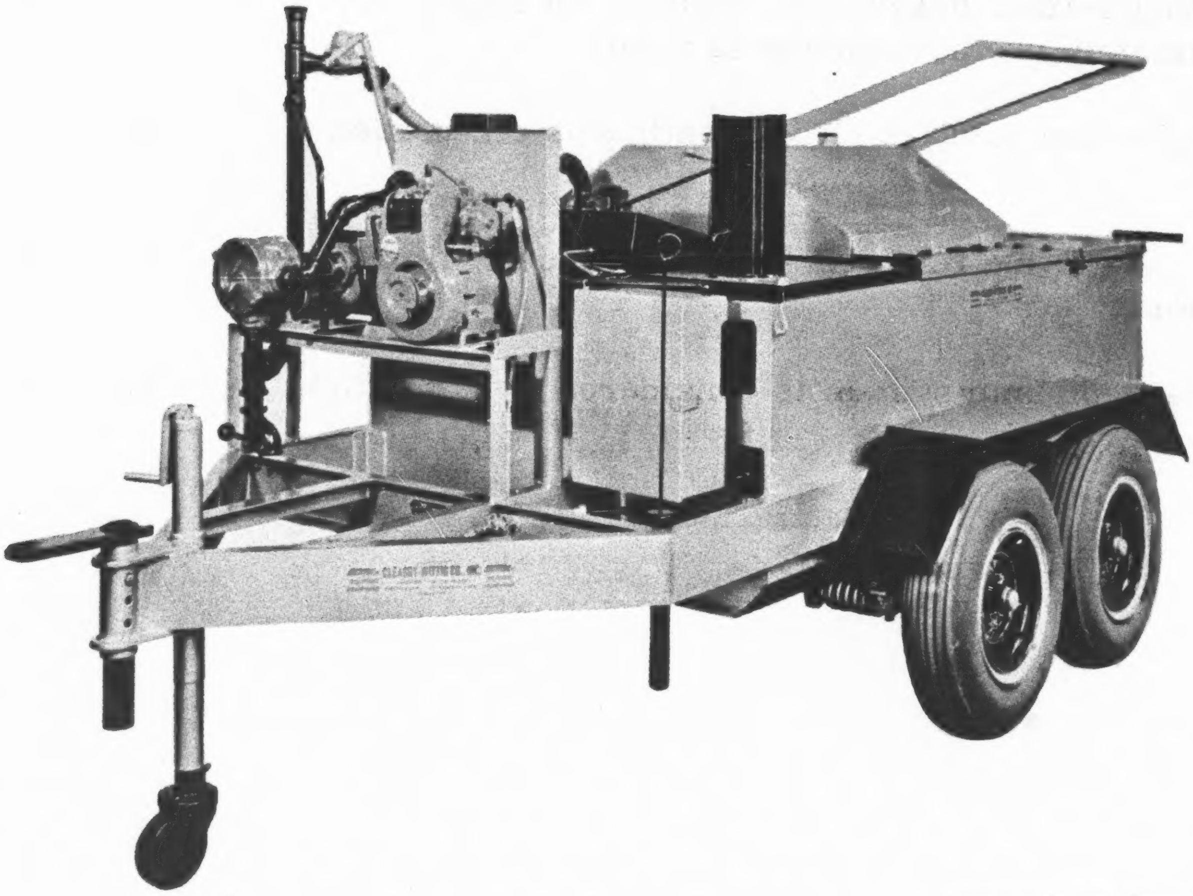
2. The engine, pump, and supply lines are all attached directly to the kettle, which saves considerable time and effort over that required by a ground pump.

3. Thin wall tubing is simple to erect and easy to handle because of its light weight. (A 20-foot section of tubing weighs only 19 pounds.)

4. This type of pumping system has been used to carry hotstuff to heights of over 150 feet.

Submerged pumping systems. A new type of pumping system, known as the submerged pump unit, is generally classified as a light-duty system. It consists of a small pump, either rotary gear or centrifugal, mounted inside the kettle and immersed in the bitumen. A small engine is mounted on the kettle rear platform and connected to the pump by means of a drive shaft.

When the pump is in operating, a continuous circulation of hotstuff is established. The hot material is picked up at one point in the kettle and elevated to a line mounted just above the kettle platform, where it is returned again to the kettle a short distance from the pick-up point.



Courtesy Cleasby-Wittig Co.

Fig. 70. Typical 540-gallon thermostatically controlled, single-line heavy-duty pump kettle

A quick-opening valve is mounted on this line which, when in open position, allows continuous circulation from kettle to line and back to kettle. To elevate the hot material to the roof, the roofer has only to pull on a control rope which closes the line valve, and the material is diverted to the line of thin wall tubing running up to the roof, where the hotstuff is run into a receptacle.

This system is considered light duty because the limit of the centrifugal pump is only about 60 feet elevation and that of the rotary gear pump about 100 feet.

The main advantage of the submerged system is that the pump, being immersed in the bitumen, is hot whenever the bitumen is hot and the operation begins as soon as the engine is started.

The submerged system has its disadvantages in that the smaller pump and engine are more susceptible to vibration and will not last as long nor perform as well as a heavy-duty system.

Checkup

One of the first pump systems used in roofing was the double-line system. 1. T F

In the single-line, heavy-duty system, an engine of approximately two horsepower is used. 2. T F

The single-line setup is also a continuous circulation system. 3. T F

Supply lines to the roof are generally made of flexible metal hose. 4. T F

A submerged pump system is considered to be for light duty. 5. T F

GLOSSARY

The definitions of terms included in this glossary are those that are pertinent to the roofing trade and are not necessarily those found in standard dictionaries. Some of the terms included are colloquial in nature and are used with the meanings applicable only to the roofing trade.

A-frame	A portable frame built in the shape of a letter "A" and used by roofers to hoist materials.
Apex	The point, tip, or summit of anything; the highest point of any roof or structure.
Arch	A curved or pointed structural member which is supported at the sides or ends; to cover with a curved structure or to form a bent top or covering.
Architect	One who plans or designs buildings.
Architecture	The art or science of designing buildings; the style of a building.
Asbestos	A fibrous, noncombustible mineral used to make fire-retardant roofing.
Asphalt	A brownish-black, natural petroleum residue used in applying roofing.
Back-fill	Dirt used to fill in about a structure after the waterproofing and foundation work are completed; provides a slope for drainage away from the foundation.
Backing	Lumber placed behind or between other members to give support and strength.
Back-mopping	Mopping the back or underside of roofing.
Base sheet	The first layer of roofing applied on the deck. Also a dry or slip sheet.
Beam	A long piece of timber or iron used to support the rafters of a building; a horizontal timber or support.

Bevel	To give a sloping edge; to slant or incline. (T bevel: a tool used to test accuracy of beveled edges.)
Bind	To cause to stick together.
Bitumen	Coal tar pitch or asphalt.
Bleeding	The draining or loosening of saturants from the roofing material.
Blister	A swelling and separating of the top layer of roofing from the underfelts. A bladder-like air pocket.
Bond	To fasten or stick together.
Bonded roof	A roof that is secure or assured of satisfactory performance.
Boom	A strong chain, cable, or line; a long pole attached to a derrick to steady or guide in hoisting.
Brace	A piece of wood or other material that holds anything tightly or supports it firmly; a prop.
Brooming	The act of sweeping in roofing felts with a broom.
Buckles	Bends, crumples, or curls in roofing.
Building code	Governmental rules and regulations for building.
Built-up roof	Roof formed by a number of layers of roofing mopped together with hot asphalt or pitch.
Burner	An apparatus that emits flame used to heat a kettle or to dry off roofs.
Butt	Short length of material; the unused end portion of a roll of roofing.
Butter	To smooth on plastic with a trowel.
Butt joint	Two pieces of roofing material fitted squarely against each other without overlapping.
Cable	A heavy rope or chain.

Canopy	An overhanging covering.
Cantilever	A projecting beam supported at only one end.
Cant strips	Triangular shaped material installed on a roof deck in the angles formed by the intersection of vertical and horizontal surfaces.
Canvas	A heavy, strong cloth used for roofing decks.
Cap sheet	A finish roofing material, used as a covering for a roof.
Caulk	To make watertight by plugging with mastic.
Chalk line	A heavy string or cord used for lining purposes.
Chicken ladder	A lightweight ladder used to hang over the ridge on steep roofs.
Circumference	The perimeter of a circle; a line that bounds a circular plane surface.
Cleat	A strip of wood or metal fastened across other materials for additional strength; may be nailed against the wall for supporting an object.
Coal tar pitch	A thick, dark liquid obtained by distillation of soft coal; used for roofing and waterproofing.
Coating liquid	A liquid with an asphalt or coal tar base used for preserving roofs.
Concealed gutter	An eaves trough installed or lowered into the roof in such a way that it is invisible.
Condensation	The change from vapor to liquid form, as from steam to water.
Connection	The act or means of joining or uniting.
Coping	The top covering of a wall; may be metal, tile, masonry, or wood.
Cornice	A horizontal molded projection at the top of a building; also the plastered underside of the eaves.

Corrugated roofing	Roofing shaped into alternate ridges and grooves.
Counterflashing	Flashing that extends over another flashing.
Course	A continuous row or layer of shingles or other roofing material.
Creosote	A by-product of coal used for preservation of wood surfaces and in waterproofing materials.
Crowbar	A long heavy steel bar, pointed or wedge-shaped at the working end.
Cupola	A hemispherical roof; a small structure above the roof.
Curb	A protective rim.
Cured	Completely dry; moisture free.
Cutback	Asphalt dissolved into its liquid form.
Dampproofing	The application of coatings of hot or cold bitumens or the use of membranes to keep out dampness.
Debris	Accumulated rubbish, trash, and fragments of roofing.
Deck	The roof surface to be covered; a small platform used for walking.
Derrick	A framework, with a long beam, ropes, gear, and pulleys used for hoisting heavy weights.
Detail	One of the many minor parts into which a building may be divided; a drawing of such a part.
Diagonal	Crossing obliquely as from corner to corner.
Diameter	A line through the center, as of a circle or sphere, terminated at the boundary thereof.
Diamond-point	A rolled, split roofing with the edges cut in the form of a diamond.
Diverter	A piece of metal bent at right angles to change the flow of rain water.

Dormer window	A vertical window rising from a sloping roof.
Downspout	A pipe or conductor to carry the water from a roof.
Draftsman	One who makes plans and mechanical drawings.
Dragline	A guideline rope.
Drain	A pipe to drain water from the roof.
Drip	Roofing extended over the edge of a roof; a projecting member shaped to throw off rain.
Dutchman	A piece of roofing placed or fitted over a poorly made corner or cut.
Eaves	The projecting lower edge of a roof.
Eaves trough	A gutter along the eaves of a roof for carrying off rain water.
Emulsion	An asphalt and water mixture used in dampproofing and roof coating. After drying, the asphalt remains.
End lap	The material lapped at the point at which the ends of two pieces of roofing material are joined.
Expansion joint	A metal flashing installed on a roof to compensate for expansion and contraction.
Exposure	The portion of roofing exposed to the weather.
Fabric	Cotton or glass cloth saturated with asphalt.
Felt (dry)	A roofing material manufactured from cellulose fibers of rags, paper, wood, and asbestos.
Fiberboard	Wood pulp that is molded into a sheet and used for insulation.
Fiber	A tough substance that is separated into threads and spun or woven.
Firewall	A wall erected above the roof to block fires between sections of the building.

Fishmouth	Open seam or ripple on roof surface.
Flashing	Sheets of metal or other suitable materials used to make watertight joints in roofs.
Flash point	The temperature at which asphalt or tar, when slowly heated, gives off vapors that will ignite upon the application of a flame.
Flopping	Lifting and dropping a sheet of roofing in a specific place.
Flue	A channel or passage for smoke or gases of combustion; a chimney.
Flush	A term applied to surfaces that are level and form a single unbroken surface.
Gable roof	A ridged, double-sloping roof.
Galvanized iron	Iron coated with zinc.
Gambrel roof	A gable roof with its slopes broken by an obtuse angle; a gable roof with two pitches in one field.
Gauntlet	A modern glove with long wrist extension.
Girder	The large supporting, spanning beam of a roof; a main spanning beam.
Glaze	To apply a very thin mopping of hot material; to sprinkle a roof with water and mop with hot asphalt.
Granite	A rock used for roof gravel.
Graphite	A variety of carbon used in roofing stains and coatings.
Gravel	Crushed stone or rock used for surfacing roofs.
Gutter	A trough installed along the eaves to carry off water.
Hand line	A rope used by hand to hoist light loads.
Hanger	A metal strap used to secure or hang gutters along the eaves.

Hatch	An opening in the roof; an access hole to the attic.
Header	Sheets of roofing laid around openings or parallel with the walls or the edges of the roof.
Hexagon	A figure with six sides.
Hexagonal shingle	A composition shingle with six sides.
Hip roof	A roof having sloping ends, thus four sloping sides. The line where adjacent sloping sides meet is called a hip.
Hoist	A hoisting machine; to pull up.
Holiday	A space or spot on the roof that is missed or unmopped.
Horizontal	In the direction of or parallel to the horizon.
"Hot" or "hotstuff"	A term used for asphalt or coal tar pitch after it has been heated.
Imbricated	Overlapped in regular order, as is done with shingles.
Impregnate	To cause to be filled or permeated with; to saturate.
Incline	A slope; a sloping surface.
Insulation	A material to prevent the passage of heat or sound; also used to reduce fire hazard.
Inverted	In an opposite position, or turned upside down.
Irish	An imported brownish roll fiber material used for flashing purposes.
Jack, roof	A device used in scaffolding a roof; a flashing used to cover pipes and vents.
Joasam drain	A patented outlet or drain used on flat roof decks.
Joint	The point at which two or more surfaces are united.
Joist	A horizontal timber to which the boards of a floor or lath on a ceiling are fastened.

Kerosene	A light, colorless petroleum fuel used in kettle burners and for cleaning uses.
Kettle	A metal vessel for heating asphalt or coal tar pitch.
Kettleman	A man who operates a kettle.
LP gas	A liquid petroleum product (butane or propane) used as fuel on certain kettle burners.
Lead	A bluish white metal used for pipes, roofs, and gutters.
Leader	A downspout that carries water from the roof to ground level.
Lean-to roof	Roof sloped one way; a shed roof.
Lightwell	A shaft or opening in the center of a building used to obtain light and ventilation for inside rooms.
Lining	Marking of a roof with a chalk line.
Linen	An asphalt-impregnated webbing.
Marble chips	Crushed marble.
Marquee	A covered roof extending out from a building.
Mastic	Thick adhesive mixture of preparations such as asphalt; used for repairing roofs.
Membrane	An asphalt-impregnated fabric; a material used for flashing.
Metal edging	A metal trim used around the outside edges of a roof.
Mission tile	A curved tapering tile unit.
Monitor	A small tower rising from the roof of a factory or other buildings, with windows or louvers, or both.
Mop yarn	A material of cotton or glass fibers used to make roofing mops.
Mortar	A mixture of sand and lime or cement and water.

Molding	A cornice or projecting decorative member used on any part of a building.
Mud	A colloquial term used for mortar.
Nailing strip	A strip of wood set in concrete along the eaves or gable of a roof.
Nail (cut)	Nails, rectangular in section, cut by machines from sheet metal.
Nail (roof)	A nail with a large head.
Nail (straw)	A galvanized nail 6" long used for nailing on tile.
Nipper (tile)	A tool with jaws for gripping and cutting tile.
Nosing	The part of the tread of a step projecting beyond the riser; a drip mounding or mold along eaves or gables.
Offset	A recess in the plane of a wall, or broken line in eave or gable of roof.
Outlet	Roof drain.
Overflow	Roof drain in wall, above outlet elevation, for excess water.
Overhang	Length of rafter projecting beyond wall line.
Pan tile	A terra cotta roof tile that is laid under a cover tile.
Parapet	A low wall above roof level.
Pencil rod	A heavy copper rod, about 1/4" in diameter, sometimes used in anchoring roof tile.
Penthouse	A room or house built upon the roof of a larger building.
Pitch	The slope of a roof, indicated by the relation of the rise to the span; also a coal tar roofing material.
Pitch pan	A metal pan filled with pitch or mastic set in hot pitch to waterproof under sign supports, angle irons, plumbing pipes, etc.

Plans	Drawings showing the proportion and relations of parts of a building.
Plaster bond	Dampproofing material sprayed or brushed on masonry and basement walls before plastering.
Plastic	Waterproofing material, composed of coal tar, asphalt, asbestos fibers, etc.
Plumb	True as indicated by a plumb line; upright, vertical, or perpendicular to the horizon.
Ply	Layers or thicknesses of roofing material.
Ply stick	Stick used in application of roofing felts to obtain proper lap and exposure.
Portal	An entrance way, especially one that is grand and imposing.
Porte-cochere	A carport attached to a building.
Portico	An open space with roof upheld by columns, often attached to a building.
Pot	Roofing kettle.
Precast	Cast beforehand, as precast gypsum roof slabs.
Primer	A thin asphalt base sprayed or brushed on roof before applying asphalt.
Protective curtain	Heavy, smooth cap sheet, nailed at top edge and left hanging loose on exterior basement walls to protect waterproof membrane when back-filling is done.
Pulley	A wheel grooved to receive a rope; used for hoisting.
Purlin	One of several horizontal timbers that support rafters.
Putty	Whiting mixed with linseed oil to consistency of dough. (Plastic is sometimes referred to as putty.)
Pyramid cleat	A raised metal cleat, sometimes used in surface nailing in windy areas, on oil tanks, etc.

Rafter	A sloping timber giving support to a roof.
Rake	The slope of a roof; or sloping edge on a gable roof that may be covered with a barge board, or verge board.
Ramp	A sloping road or corridor. Also, the concave part at the top or cap of a railing, wall, or coping.
Re-cover	To apply a new roof over an old roof.
Reglet, or raggle	Beveled nailing strips for flashing set into the masonry wall in concrete construction.
Regravelling (Double gravelling)	A double layer of gravel and floodcoats of asphalt, designed to give additional protection for dead level asphalt builtup roofs that are to be ponded with water.
Return	A part of the face of a building at an angle with the main part of the facade.
Ridge	The point on a double-sloping roof at which the rafters meet the ridge pole.
Ridge roll	A rolled metal cap to cover and finish the ridge.
Ridge shingles	Units of roofing made for ridge covering.
Rise	The vertical height of the top of a roof above the plate line, or the increase in height of a rafter per foot of run.
Rock roofing (Aggregate)	Crushed rocks of various colors and origin substituted for gravel in order to impart color to roofing surfaces.
Rolling rod	A pipe or rod used to hold a roll of roofing.
Roofing	Roofs collectively; materials for roofs; the act of covering a roof.
Rot	Decay that attacks wood. The two major types are dry rot and wet rot.
Run	Usually one-half the distance of the span of a roof.
Rung	A cross strip, as of a chair or ladder.

Saddle	A water diverter located behind a chimney. (Sometimes referred to as a cricket.)
Salamander	A white top asbestos roll roofing; usually called white top.
Saturate	To soak thoroughly.
Saw-tooth roof	A roof built in the shape of saw teeth; the vertical positions are well supplied with sash to admit light.
Scab	A cleat nailed over a joint, etc.
Scaffold	A temporary elevated structure for the support of workmen and materials during the construction of a building.
Scar	An indentation mark made on roofing.
Screen	A metal wire screen or basket used on outlets or downspouts.
Scrub	To rub vigorously; to spread the hot material very thin.
Scupper	A hole or gutter bordering a deck, to let water run off.
Seam	A visible line of junction between two parts; a ridge made in joining two sheets of roofing.
Selvage edge	A 2" or 3" sanded edge on roll roofing.
Shake	A rough, unshaved wood shingle.
Sheathing	The boards or other material used for covering the frame or roof structure.
Shingle	A unit of roofing, usually wood, composition, tile, or slate.
Shiplap	A certain form of lapping of sheets of roofing.
Side lap	The lap of roofing material along its side or edge.
Siding	Asbestos, pressed board, or lumber used in covering the exterior walls of a building.

Silica	White or colorless, extremely hard, crystalline silicon dioxide.
Skein	A fixed quantity of yarn, used in making mops.
Skylight	A window facing skyward, usually located on the roof. An opening in the roof containing a window for light and ventilation.
Slag	A refuse product of the smelting of ores that is used on roof for gravel.
Slate	A fine-grained rock that splits into thin, even layers used for roofing; a tile.
Slip sheet	A light sheet of paper applied over roof sheathing to prevent the roofing from bonding to sheathing. May be called dry sheet.
Slope	See "pitch" above.
Soffit	The underside of a beam, lintel, archway, cornice, or stairway.
Solder	Equal parts of tin and lead used to joint or patch metal.
Span	A space or distance between supports; in roof framing, width of frame between outside edges of building.
Specifications	Written information augmenting plans of a building.
Spigot	A faucet for drawing asphalt from the kettle.
Spire	A tapering or pyramidal roof of a tower; a steeple.
Splice	To unite in such a way as to form one continuous piece. To join two ropes or parts of a rope by intertwining the strands.
Split	A long crack or tear in the roofing.
Spreading rate	The quantity of bitumen, roofing aggregate, and other materials that may be spread over a roof deck in a certain time. Always given in gallons, pounds, or other designation "per square."

Spud (bar)	A sharp, narrow spade for removing gravel and roofing; to dig or remove with a spud (bar), as to remove roof gravel.
Square	A unit of measure of roofing area equal to 100 sq. ft.
Square butts	A type of double-coverage shingles.
Standing sheet	The sheet or sheets of roofing laid at the eave or lower part of the roof and around all openings on the roof.
Staple	A U-shaped piece of metal with pointed ends.
Stapler	A device used for stapling materials together.
Starter strip	A strip of roofing used at eaves of roof on first row of shingles.
Starter tile	A short piece of tile used in starting tile.
Storm collar	A narrow strip of metal formed to fit around vent pipes.
Stud	An upright piece of lumber in the walls, usually 2" × 4", to which the lath is nailed.
Tab	The lower or butt end of a shingle.
Talc	A soft magnesium silicate used on roll roofing.
Taper	To make or become smaller toward the end; to lessen gradually, growing smaller by degrees in one direction.
Tar	A by-product of coal; often referred to as coal tar or coal tar pitch.
Template	A pattern or guide of wood or metal used for shaping or marking work.
Thatch-on	A type of interlocking shingle; a method of laying a shingle.
Thick butts	Same as square butt shingles.
Tile	A thin piece of baked clay used for covering roofs, available in varied shapes.

Tile pick	A sharp pointed hammer used to pick holes in tile units.
Tile strip	Wood strips used for nailing tile on top of roofing.
Tile tie (tye)	A heavy braided wire, or flat metal strip, used in securing tile to the roof.
Tin caps	A tin flat disk, used to nail through, giving greater holding area to the nail head. Used in windy areas and on soft roofing materials.
Tin snips	Cutters used for cutting light metal.
Toe board	A protective board placed on a sloping roof to prevent workmen from slipping or falling.
Toenail	A nail driven obliquely to hold the foot of a stud or brace; also to draw boards into place.
Trowel	A flat, bladed, pointed instrument having an offset handle that is parallel with the blade.
Truss	A braced framework over long spans such as found on large roof or bridge construction; also to brace or support by a truss.
Turn-up	Roofing material turned up on a wall or at an opening usually about 4" wide.
Valley	The gutter or angle formed by the meeting of two roof slopes.
Valley metal	Sheet metal used in forming a valley.
Valley sheet	A sheet of roofing laid parallel with the valley.
Vapor seal	Material placed under insulation in order to avoid condensation of moisture inside the insulation. (An adequate vapor seal for cold climates should consist of two 15-lb. felts and two moppings of hot bitumen.)
Vault	An arched structure; an arched ceiling or roof.
Vent	An opening for the circulation of air, etc.; an outlet, as a vent pipe.

Vent sleeves (collars)	Flanged sheet metal collars placed around vent pipes that go through roofs for the purpose of sealing off the roofing around the vent pipe opening.
Ventilator	A device for gathering a supply of fresh air.
Veranda	An open portico or gallery along the side of a building usually called a porch.
Verge board	The outer false rafter on the rake of a gable, sometimes referred to as a barge board.
Water table	A strong coarse molding placed so as to throw off water.
Waterproofing	Making impervious to water by use of membranes; also the material used in the process.
Washback	Pyramid-like structure on a roof provided to direct water to a drain.
Weeper	A small opening or hole at the base of a skylight to permit the escape of water or moisture collected inside the skylight.
Whetstone	A stone for sharpening cutting tools.
Winch	Hoist used for hauling or hoisting materials to the top of a roof.
Z-bar	Metal flashing used especially on walls where roof, plaster, or wood siding meet.
Zone	A division of political subdivision (city, county) into districts that may have different building regulations.

INSTRUCTIONAL MATERIALS

Books and pamphlets listed below may be ordered from their publishers.

BOOKS RECOMMENDED FOR EACH APPRENTICE

Roofing, Part 1 (Workbook and Testbook). Sacramento: California State Department of Education. See Price List

Strahan, J. L., Manufacture, Selection, and Application of Asphalt Roofing and Siding Products. Seventh Edition, Revised, 1959. New York: Asphalt Roofing Industry Bureau, August, 1959. (757 3rd Avenue, New York 17, N.Y.) $.35

BOOKS RECOMMENDED FOR CLASSROOM LIBRARY

Construction Safety Orders, Sacramento: Division of Industrial Safety, California State Department of Industrial Relations, 1957. (Documents Section, Printing Division, N. 7th and Richards Blvd., Sacramento, Calif.) $1.00

The following free pamphlets, issued by the Division of Industrial Safety, Department of Industrial Relations, State of California (P.O. Box 603, San Francisco, Calif. 94101):

Handy Rules for Hand Tools (Bulletin 122, July, 1952)
Ladder Safety, Step By Step (Bulletin 121, Revised, May, 1957)
Safety Rules for Roofers (Bulletin 124, Revised, July, 1957)

Catalogs and other descriptive literature from roofing and kettle manufacturers, such as:

Blackwell Burner Co., P.O. Box 4426, San Antonio, Texas
Clear-Field Manufacturing, Inc., 352 South Main, Clearfield, Utah
Cleasby-Wittig Co., Inc., 2600 Ingalls St., San Francisco, Calif.
Roofmaster Products Co., P.O. Box 62023, Los Angeles, Calif. 90063
The Flintkote Company, P.O. Box 2218 Terminal Annex, Los Angeles, Calif. 90054
Universal Roof Equipment Co., 5321 East 9th, Kansas City, Mo.

SUPPLEMENTAL REFERENCES TO ENRICH THE COURSE

McCawley, James, Roofing - Estimating, Applying, and Repairing. Chicago: Shelter Publications, 1959. (180 N. Wacker Dr., Chicago, Ill.) $7.50

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